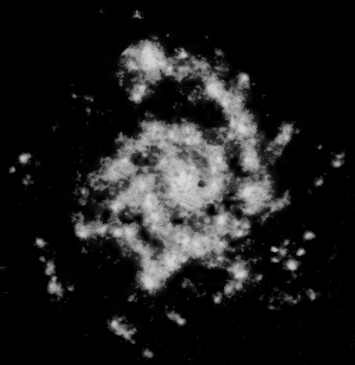
Scientific and Technical Aerospace Reports



An Abstract Journal

Volume 31, Number 8
August 1993
N93-22009 to N93-24658

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A typical citation and abstract sample explaining the standard format, which includes codes for ordering reports.

An Abstract Section
Citations and abstracts of reports and publications that provide comprehensive coverage of worldwide aerospace-related topics including aeronautics and space science technology. *STAR* lists published and publicly available reports entered into the NASA STI Database during the four weeks preceding publication of this issue. These citations and abstracts are listed by subject categories.

An Index Section
- Subject
- Personal author
- Corporate source
- Contract number
- Report number.

Appendix
A guide for ordering cited reports, registering with the NASA STI Program, and using the available products and services. Additionally, price schedules, phone numbers, and addresses are included in this information packed section.

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N.A.—no abstracts were assigned to this category for this issue.

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Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software.*

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Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

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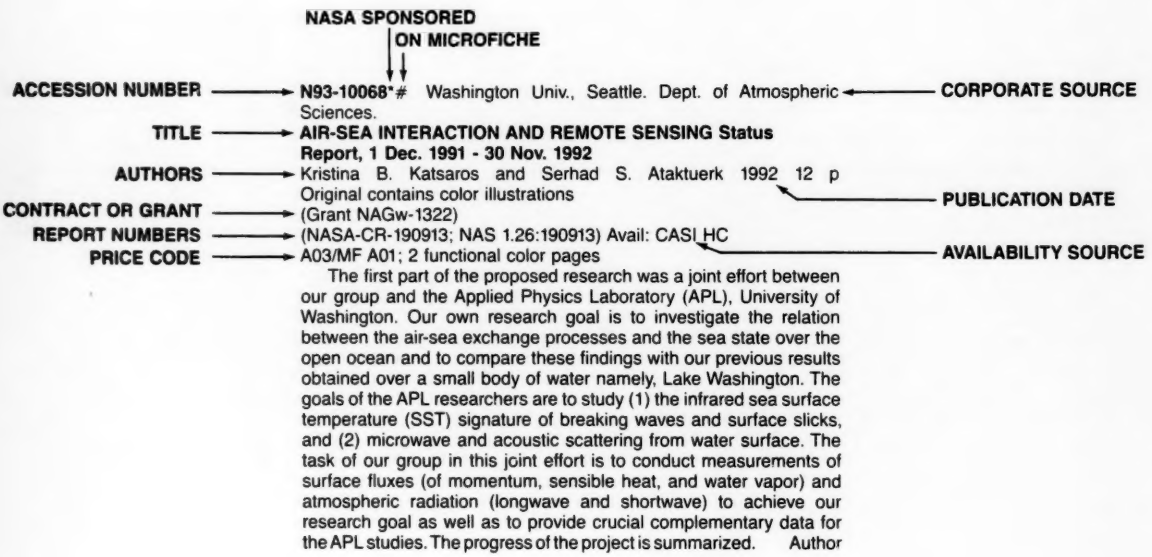
TYPICAL CITATION AND ABSTRACT



VOLUME 31 NUMBER 8 / AUGUST 1993

Scientific and Technical Aerospace Reports

A Monthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N93-22392# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Unternehmensbereich Flugzeuge.

AN EXPERT SYSTEM FOR THE DIAGNOSTIC AND MAINTENANCE OF VARIOUS AIRCRAFT COMPONENTS [EXPERTENSYSTEM FUER DIE DIAGNOSE UND WARTUNG UNTERSCHIEDLICHER KOMPONENTEN DES FLUGZEUGES]

Juergen Fey Sep. 1989 13 p In GERMAN Presented at DGLR e.V. Forschungsintitut fuer Anthropotechnik der FGAN e.V. 32nd Fachausschusssitzung, Ottobrunn, Germany, 19-20 Sep. 1989 Submitted for publication

(MBB-FE-363-S-PUB-0499; ETN-93-93438) Avail: CASI HC A03/MF A01

Maintenance costs are increasing in relation with the increasing complexity of avionic systems. The use of knowledge based systems is considered for airborne and ground based test techniques, in order to meet with the resulting requirements. A ground based diagnostic system is developed, which can give guidance to the maintenance engineer at debriefing, on a necessary checkout of avionic components on special testing bench. It can avoid suppposedly defective modules being unnecessarily replaced and expensive test procedures being undertaken. ESA

N93-22397# General Accounting Office, Washington, DC. National Security and International Affairs Div.

REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON DEFENSE, COMMITTEE ON APPROPRIATIONS, HOUSE OF REPRESENTATIVES. INTELLIGENCE PROGRAMS: NEW RC-135 AIRCRAFT ENGINES CAN REDUCE COST AND IMPROVE PERFORMANCE

Aug. 1992 8 p

(AD-A259283; GAO/NSIAD-92-305) Avail: CASI HC A02/MF A01

In response to a request, information on the replacement of engines for the Department of Defense's fleet of 21 RC-135 aircraft are provided to the Subcommittee on Defense. This report addresses: (1) the estimated cost to replace the RC-135 aircraft's TF-33 engines; (2) the projected savings in future opearation and maintenance costs by replacing the engines; and (3) the operational benefits resulting from engine replacement. CASI

N93-22561*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

JOINT UNIVERSITY PROGRAM FOR AIR TRANSPORTATION RESEARCH, 1991-1992

Frederick R. Morrell, comp. Washington Feb. 1993 169 p Conference held in Athens, OH, 18-19 Jun. 1992; sponsored by NASA, Washington and FAA

(Grants NGL-22-009-640; NGL-31-001-252; NGR-36-009-017; RTOP 505-64-52-01)

(NASA-CP-3193; L-17195; NAS 1.55:3193) Avail: CASI HC A08/MF A02

This report summarizes the research conducted during the academic year 1991-1992 under the FAA/NASA sponsored Joint University Program for Air Transportation Research. The year end review was held at Ohio University, Athens, Ohio, June 18-19, 1992. The Joint University Program is a coordinated set of three grants sponsored by the Federal Aviation Administration and NASA Langley Research Center, one each with the Massachusetts Institute of Technology (NGL-22-009-640), Ohio University (NGR-36-009-017), and Princeton University (NGL-31-001-252). Completed works, status reports, and annotated bibliographies are presented for research topics, which include navigation, guidance and control theory and practice, intelligent flight control, flight dynamics, human factors, and air traffic control processes. An overview of the year's activities for each university is also presented. For individual titles, see N93-22562 through N93-22576.

N93-22562*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.

AN INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 1991-1992 **c03**

Robert W. Simpson *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 3-7 (For primary document see N93-22561 08-01)

Avail: CASI HC A01/MF A02

There are two completed projects and five new or continuing research activities under the sponsorship of the FAA/NASA Joint University Program as the 1991-92 period ends. A brief summary of some of the continuing research projects is provided. The active research projects are: (1) extensions for the FASA (Final Approach Spacing Advisory) System; (2) radar tracking around a turn; (3) impact of advanced technologies of single pilot IFR operations; (4) system and human limitations in millimeter wave and infrared synthetic vision systems; and (5) differences in party line information usage by operational user groups. Derived from text

N93-22563*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.

THE ASLOTS CONCEPT: AN INTERACTIVE, ADAPTIVE DECISION SUPPORT CONCEPT FOR FINAL APPROACH SPACING OF AIRCRAFT (FASA). FAA-NASA JOINT UNIVERSITY PROGRAM **c04**

Robert W. Simpson *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 9-20 (For primary document see N93-22561 08-01)

Avail: CASI HC A03/MF A02

This presentation outlines a concept for an adaptive, interactive decision support system to assist controllers at a busy airport in achieving efficient use of multiple runways. The concept is being implemented as a computer code called FASA (Final Approach Spacing for Aircraft), and will be tested and demonstrated in ATCSIM, a high fidelity simulation of terminal area airspace and airport surface operations. Objectives are: (1) to provide automated cues to assist controllers in the sequencing and spacing of landing and takeoff aircraft; (2) to provide the controller with a limited ability to modify the sequence and spacings between aircraft, and to insert takeoffs and missed approach aircraft in the landing flows; (3) to increase spacing accuracy using more complex and precise separation criteria while reducing controller workload; and (4) achieve higher operational takeoff and landing rates on multiple runways in poor visibility. Author

N93-22564*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

HAZARD EVALUATION AND OPERATIONAL COCKPIT DISPLAY OF GROUND-MEASURED WINDSHEAR DATA **c03**

Craig Wanke and R. John Hansman, Jr. *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 21-27 Presented at the AIAA 28th Aerospace Sciences Meeting, Reno, NV, 8-11 Jan. 1990 Previously announced in IAA as A90-19919 and A92-41216 (For primary document see N93-22561

08-01)
(Grants NAG1-690; NGL-22-009-640)
(AIAA Paper 90-0566) Avail: CASI HC A02/MF A02

Low-altitude windshear is the leading weather-related cause of fatal aviation accidents in the U.S. Since 1964, there have been 26 accidents attributed to windshear resulting in over 500 fatalities. Low-altitude windshear can take several forms, including macroscopic forms such as cold-warm gustfronts down to the small, intense downdrafts known as microbursts. Microbursts are particularly dangerous and difficult to detect due to their small size, short duration, and occurrence under both heavy precipitation and virtually dry conditions. For these reasons, the real-time detection of windshear hazards is a very active field of research. Also, the advent of digital ground-to-air datalinks and electronic flight instrumentation opens up many options for implementation of windshear alerts in the terminal area environment. Study is required to determine the best content, format, timing, and cockpit presentation of windshear alerts in the modern ATC environment to best inform the flight crew without significantly increasing crew workload. Author

N93-22565*# Massachusetts Inst. of Tech., Cambridge.
HEAT TRANSFER ON ACCRETING ICE SURFACES **c03**
Keiko Yamaguchi and R. John Hansman, Jr. *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 29-34 Presented at the AIAA 28th Aerospace Sciences Meeting, Reno, NV, 8-11 Jan. 1990 Previously announced in IAA as A90-22181 and A92-24415 Sponsored in part by NSF (For primary document see N93-22561 08-01)
(Grants NAG3-666; NGL-22-009-640)
(AIAA Paper 90-0200) Avail: CASI HC A02/MF A02

Based on previous observations of glaze ice accretion on aircraft surfaces, a multizone model with distinct zones of different surface roughness is demonstrated. The use of surface roughness in the LEWICE ice accretion prediction code is examined. It was found that roughness is used in two ways: (1) to determine the laminar to turbulent boundary-layer transition location; and (2) to calculate the convective turbulent heat-transfer coefficient. A two-zone version of the multizone model is implemented in the LEWICE code, and compared with experimental convective heat-transfer coefficient and ice accretion results. The analysis of the boundary-layer transition, surface roughness, and viscous flowfield effects significantly increased the accuracy in predicting heat-transfer coefficients. The multizone model was found to significantly improve the ice accretion prediction for the cases compared. Author

N93-22566*# Massachusetts Inst. of Tech., Cambridge. Aeronautical Systems Lab.
HAZARD ALERTING AND SITUATIONAL AWARENESS IN ADVANCED AIR TRANSPORT COCKPITS **c03**
R. John Hansman, Craig Wanke, James Kuchar, Mark Mykityshyn, Edward Hahn, and Alan Midkiff *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 35-45 Previously announced in IAA as A93-14377 (For primary document see N93-22561 08-01)
(Contract NAG2-12; NAG2-716; NAG1-690; NGL-22-009-640; DTRS-57-88-C-00078; NSF MSS-05-52702)
Avail: CASI HC A03/MF A02

Advances in avionics and display technology have significantly changed the cockpit environment in current 'glass cockpit' aircraft. Recent developments in display technology, on-board processing, data storage, and datalinked communications are likely to further alter the environment in second and third generation 'glass cockpit' aircraft. The interaction of advanced cockpit technology with human cognitive performance has been a major area of activity within the MIT Aeronautical Systems Laboratory. This paper presents an overview of the MIT Advanced Cockpit Simulation Facility. Several recent research projects are briefly reviewed and the most important results are summarized. Author

N93-22567*# Ohio Univ., Athens.
A HYBRID VOICE/DATA MODULATION FOR THE VHF AERONAUTICAL CHANNELS **c32**
Dennis M. Akos *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 53-65 (For primary document see N93-22561 08-01)
Avail: CASI HC A03/MF A02

A method of improving the spectral efficiency of the existing Very High Frequency (VHF) Amplitude Modulation (AM) voice communication channels is proposed. The technique is to phase modulate the existing voice amplitude modulated carrier with digital data. This allows the transmission of digital information over an existing AM voice channel with no change to the existing AM signal format. There is no modification to the existing AM receiver to demodulate the voice signal and an additional receiver module can be added for processing of the digital data. The existing VHF AM transmitter requires only a slight modification for the addition of the digital data signal. The past work in the area is summarized and presented together with an improved system design and the proposed implementation. Author

N93-22568*# Ohio Univ., Athens.
FAULT DETECTION AND ISOLATION **c04**
Greg Bernath *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 67-76 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

Erroneous measurements in multisensor navigation systems must be detected and isolated. A recursive estimator can find fast growing errors; a least squares batch estimator can find slow growing errors. This process is called fault detection. A protection radius can be calculated as a function of time for a given location. This protection radius can be used to guarantee the integrity of the navigation data. Fault isolation can be accomplished using either a snapshot method or by examining the history of the fault detection statistics. Author

N93-22569*# Ohio Univ., Athens.
GPS MULTIPATH ERRORS IN THE PRECISION LANDING ENVIRONMENT **c04**
James D. Waid *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 77-88 (For primary document see N93-22561 08-01)
(Grants NAG1-1423; NGR-36-009-017)
Avail: CASI HC A03/MF A02

Aircraft guidance and positioning during the final approach and landing phases of flight requires a high degree of accuracy. The Global Positioning System operating in differential mode (DGPS) is being considered for this application. Prior to implementation, all sources of error must be considered. Multipath has been shown to be the dominant source of error for DGPS. Theoretical studies have verified the severity of multipath within the final approach and landing regions. This paper presents a study of GPS multipath errors during these critical phases of flight. A discussion of GPS multipath error characteristics will be presented along with actual multipath data. The data was collected using P-code and C/A-code receiver architectures. Data was collected onboard a dual-engine fixed-wing research aircraft. Aircraft dynamics are considered in the data analysis. Author

N93-22570*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT PRINCETON UNIVERSITY, 1991-1992 **c03**
Robert F. Stengel *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 91-100 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

The Air Transportation Research Program at Princeton University proceeded along six avenues during the past year: (1) intelligent flight control; (2) computer-aided control system design; (3) neural networks for flight control; (4) stochastic robustness of flight control systems; (5) microburst hazards to aircraft; and (6) fundamental dynamics of atmospheric flight. This research has resulted in a number of publications, including archival papers and conference papers. An annotated bibliography of publications that appeared between June 1991 and June 1992 appears at the end of this report. The research that these papers describe was supported in whole or in part by the Joint University Program, including work that was completed prior to the reporting period. Author

N93-22571*# Princeton Univ., NJ.
ADVANCED AIR TRAFFIC MANAGEMENT **c04**
J. P. Wangermann *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 101-106 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

Air traffic worldwide continues to grow, and this growth is predicted to continue in the coming decades. Air traffic management (ATM) systems in several parts of the world have now reached their operating limits. The external symptoms of this are increases in the number of delays experienced by the system, and a rise in the frequency of near-misses. If the ATM system fails to develop to provide more capacity, then the result will be a decrease in safety levels, and increasing delays, or a limit on the number of permitted aircraft operations. Author

N93-22572*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
COMPUTER AIDED CONTROL SYSTEM DESIGN (CACSD) **c04**
Frank T. Stoner *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 107-113 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

The design of modern aerospace systems relies on the efficient utilization of computational resources and the availability of computational tools to provide accurate system modeling. This research focuses on the development of a computer aided control system design application which provides a full range of stability analysis and control design capabilities for aerospace vehicles. Author

N93-22573*# Princeton Univ., NJ.
SYNTHESIS OF ROBUST CONTROLLERS **c04**
Chris Marrison *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 115-127 (For primary document see N93-22561 08-01)
Avail: CASI HC A03/MF A02

At the 1990 American Controls Conference a benchmark problem was issued as a challenge for designing robust compensators. Many compensators were presented in response to the problem. In previous work Stochastic Robustness Analysis (SRA) was used to compare these compensators. In this work SRA metrics are used as guides to synthesize robust compensators, using the benchmark problem as an example. Author

N93-22574*# Princeton Univ., NJ.
OPTIMAL RECOVERY FROM MICROBURST WIND SHEAR **c03**
Sandeep S. Mulgund *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 129-140 (For primary document see N93-22561 08-01)
Avail: CASI HC A03/MF A02

Severe low-altitude wind variability represents an infrequent but significant hazard to aircraft taking off or landing. During the period from 1964 to 1985, microburst wind shear was a contributing factor in at least 26 civil aviation accidents involving nearly 500 fatalities and over 200 injuries. A microburst is a strong localized downdraft that strikes the ground, creating winds that diverge radially from the impact point. The physics of microbursts have only been recently understood in detail, and it has been found that effective recovery from inadvertent encounters may require piloting techniques that are counter-intuitive to flight crews. The goal of this work was to optimize the flight path of a twin-jet transport aircraft encountering a microburst during approach to landing. The objective was to execute an escape maneuver that maintained safe ground clearance and an adequate stall margin during the climb-out portion of the trajectory. Author

N93-22575*# Princeton Univ., NJ.
DYNAMIC RESPONSE AND CONTROL OF A JET-TRANSPORT AIRCRAFT ENCOUNTERING A SINGLE-AXIS VORTEX **c08**
Darin R. Spilman *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 141-150 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

The dynamic responses of a jet-transport aircraft to two types of single-axis wind vortex encounters are studied. Aircraft attitude, flight path angle, and aerodynamic angle excursions are analyzed and dominating dynamic forcing effects are identified for each encounter. A simple departure-preventing LQR controller is designed to demonstrate the benefits of using automatic control to reduce the wind vortex hazard. A Proportional-Integral-Filter controller structure successfully regulates the critical parameters, roll angle, phi, and sideslip angle, beta, for the two different vortex encounters considered in this study. Author

N93-22576*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
INTELLIGENT FLIGHT CONTROL SYSTEMS **c08**
Robert F. Stengel *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1992-1992 Feb. 1993 p 151-172 Presented at the Aerospace Vehicle Dynamics and Control, Bedford, England, 7-10 Sep. 1992 (For primary document see N93-22561 08-01)
(Contract NGL-31-001-252; DAAL03-89-K-0092)
Avail: CASI HC A03/MF A02

The capabilities of flight control systems can be enhanced by designing them to emulate functions of natural intelligence. Intelligent control functions fall in three categories. Declarative actions involve decision-making, providing models for system monitoring, goal planning, and system/scenario identification. Procedural actions concern skilled behavior and have parallels in guidance, navigation, and adaptation. Reflexive actions are spontaneous, inner-loop responses for control and estimation. Intelligent flight control systems learn knowledge of the aircraft and its mission and adapt to changes in the flight environment. Cognitive models form an efficient basis for integrating 'outer-loop/inner-loop' control functions and for developing robust parallel-processing algorithms. Author

N93-23038*# National Aeronautics and Space Administration, Washington, DC.
AERONAUTICAL ENGINEERING: A CUMULATIVE INDEX TO A CONTINUING BIBLIOGRAPHY (SUPPLEMENT 287)
Feb. 1993 694 p
(NASA-SP-7037(287); NAS 1.21:7037(287)) Avail: CASI HC A99

This publication is a cumulative index to the abstracts contained in Supplements 275 through 286 of Aeronautical Engineering: A Continuing Bibliography. The bibliographic series is compiled through the cooperative efforts of the American Institute of Aeronautics and Astronautics (AIAA) and the National Aeronautics and Space Administration (NASA). Seven indexes are included -- subject, personal author, corporate source, foreign technology, contract number, report number and accession number. Author

N93-23039* National Aeronautics and Space Administration, Washington, DC.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 288)
Feb. 1993 192 p
(NASA-SP-7037(288); NAS 1.21:7037(288)) Avail: CASI HC A09

This bibliography lists 661 reports, articles, and other documents introduced into the NASA scientific and technical information system in Jan. 1993. Subject coverage includes: design, construction, and testing of aircraft and aircraft engines; aircraft components, equipment, and systems; ground support systems; and theoretical and applied aspects of aerodynamics and general fluid dynamics. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N93-22015*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SWEPT WING ATTACHMENT LINE CONTAMINATION FENCE Patent Application
Bruce J. Holmes, inventor (to NASA) 13 Dec. 1991 9 p

(NASA-Case-LAR-13400-1; NAS 1.71:LAR-13400-1; US-Patent-Appl-SN-806066) Avail: CASI HC A02/MF A01

A device for controlling attachment line contamination on an airfoil is presented. A fence is installed on the leading edge of the airfoil in the freestream direction perpendicular to the airfoil, outboard of the fuselage boundary layer. The inboard side of the fence arrests the spanwise movement of the turbulent boundary layer while the laminar boundary layer on the outboard side of the fence eliminates any further turbulent contamination of the attachment line. NASA

N93-22395# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.

AN APPROXIMATE METHOD FOR ESTIMATING THE LIFTING CHARACTERISTICS OF THIN BODIES OF NON-CIRCULAR CROSS-SECTION

P. A. T. Christopher Jan. 1990 100 p

(Cranfield-Aero-9006; ISBN-1-871564-42-5; ETN-93-93551) Avail: CASI HC A05/MF A02; Cranfield Inst. of Tech., Coll. Aeronautics, Cranfield, Bedford MK43 0AL, England, HC

A method based on that of Sacks for predicting the normal force distribution in thin bodies of noncircular cross section is developed. From this, the ratio, F(sub N), between the normal force gradient on the body of noncircular cross section and that of circular cross section, is calculated, the cross sectional area distribution, in the axial sense, being the same for both bodies. From a known, accurate, distribution on a body of revolution, the distribution on related families of bodies of noncircular cross section can be calculated, simply by multiplying by F(sub N)(x). The accurate distribution on the body of revolution may come from any convenient source including experiment. One way is to generate the lifting body by means of axial distributions of doublets. Both the indirect and direct aerodynamic problems are addressed and the technique is shown to offer a possible means for the design of lifting bodies. ESA

N93-22457*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

WING FLUTTER BOUNDARY PREDICTION USING AN UNSTEADY EULER AERODYNAMIC METHOD

Elizabeth M. Lee-Rausch and John T. Batina Mar. 1993 13 p Proposed for presentation at the 34th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, La Jolla, CA, Apr. 1993

(RTOP 505-63-50-12)

(NASA-TM-107732; NAS 1.15:107732) Avail: CASI HC A03/MF A01

Modifications to an existing three-dimensional, implicit, upwind Euler/Navier-Stokes code (CFL3D Version 2.1) for the aeroelastic analysis of wings are described. These modifications, which were previously added to CFL3D Version 1.0, include the incorporation of a deforming mesh algorithm and the addition of the structural equations of motion for their simultaneous time-integration with the government flow equations. The paper gives a brief description of these modifications and presents unsteady calculations which check the modifications to the code. Euler flutter results for an isolated 45 degree swept-back wing are compared with experimental data for seven freestream Mach numbers which define the flutter boundary over a range of Mach number from 0.499 to 1.14. These comparisons show good agreement in flutter characteristics for freestream Mach numbers below unity. For freestream Mach numbers above unity, the computed aeroelastic results predict a premature rise in the flutter boundary as compared with the experimental boundary. Steady and unsteady contours of surface Mach number and pressure are included to illustrate the basic flow characteristics of the time-marching flutter calculations and to aid in identifying possible causes for the premature rise in the computational flutter boundary. Author

N93-22487*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

AUTOMATIC COMPUTATION OF WING-FUSELAGE INTERSECTION LINES AND FILLET INSERTS WITH FIXED-AREA CONSTRAINT

Raymond L. Barger and Mary S. Adams Washington Mar. 1993 19 p

(RTOP 505-59-53-01)

(NASA-TM-4406; L-17131; NAS 1.15:4406) Avail: CASI HC A03/MF A01

Procedures for automatic computation of wing-fuselage juncture geometry are described. These procedures begin with a geometry in wave-drag format. First, an intersection line is computed by extrapolating the wing to the fuselage. Then two types of filleting procedures are described, both of which utilize a combination of analytical and numerical techniques appropriate for automatic calculation. An analytical technique for estimating the added volume due to the fillet is derived, and an iterative procedure for revising the fuselage to compensate for this additional volume is given. Sample results are included in graphical form. Author

N93-22552*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SPATIAL ADAPTATION PROCEDURES ON TETRAHEDRAL MESHES FOR UNSTEADY AERODYNAMIC FLOW CALCULATIONS

Russ D. Rausch, John T. Batina, and Henry T. Y. Yang Feb. 1993 15 p Presented at the AIAA 31st Aerospace Sciences Meeting, Reno, NV, 11-14 Jan. 1993 Previously announced in IAA as A93-21116

(RTOP 505-63-50-12)

(NASA-TM-107726; NAS 1.15:107726) Avail: CASI HC A03/MF A01

Spatial adaptation procedures for the accurate and efficient solution of steady and unsteady inviscid flow problems are described. The adaptation procedures were developed and implemented within a three-dimensional, unstructured-grid, upwind-type Euler code. These procedures involve mesh enrichment and mesh coarsening to either add points in high gradient regions of the flow or remove points where they are not needed, respectively, to produce solutions of high spatial accuracy at minimal computational cost. A detailed description of the enrichment and coarsening procedures are presented and comparisons with experimental data for an ONERA M6 wing and an exact solution for a shock-tube problem are presented to provide an assessment of the accuracy and efficiency of the capability. Steady and unsteady results, obtained using spatial adaptation procedures, are shown to be of high spatial accuracy, primarily in that discontinuities such as shock waves are captured very sharply. Author

N93-22558*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SUBSONIC AERODYNAMIC CHARACTERISTICS OF A PROPOSED ADVANCED MANNED LAUNCH SYSTEM ORBITER CONFIGURATION

George M. Ware and Charles H. Fox, Jr. Washington Feb. 1993 30 p

(RTOP 506-40-61-01)

(NASA-TM-4439; L-17182; NAS 1.15:4439) Avail: CASI HC A03/MF A01

The Advanced Manned Launch System is a proposed near-term technology, two-stage, fully reusable launch system that consists of an unmanned glide-back booster and a manned orbiter. An orbiter model that featured a large fuselage and an aft delta wing with tip fins was tested in the Langley 7- by 10-Foot High-Speed Tunnel. A crew cabin, large payload fairing, and crew access tunnel were mounted on the upper body. The results of the investigation indicated that the configuration was longitudinally stable to an angle of attack of about 6 deg about a center-of-gravity position of 0.7 body length. The model had an untrimmed lift-drag ratio of 6.6, but could not be trimmed at positive lift. The orbiter model was also directionally unstable. The payload fairing was responsible for about half the instability. The tip-fin controllers, which are designed as active controls to produce artificial directional stability, were effective in producing yawing moment, but sizable adverse rolling moment occurred at angles of attack above 6 deg. Differential deflection of the elevon surfaces was effective in producing rolling moment with only small values of adverse yawing moment. Author

N93-22654*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

FLIGHT INVESTIGATION OF THE EFFECT OF TAIL BOOM STRAKES ON HELICOPTER DIRECTIONAL CONTROL

Henry L. Kelly, Cynthia A. Crowell, Kenneth R. Yenni, and Michael B. Lance (Lockheed Engineering and Sciences Co., Hampton, VA.) Washington Feb. 1993 42 p

(DA Proj. 1L1-62211-A-47-A; RTOP 505-59-36-01)

(NASA-TP-3278; L-17068; NAS 1.60:3278; ATCOM-TR-93-A-003) Avail: CASI HC A03/MF A01

A joint U.S. Army/NASA flight investigation was conducted utilizing a single-rotor helicopter to determine the effectiveness of horizontally mounted tail boom strakes on directional controllability and tail rotor power during

low-speed, crosswind operating conditions. Three configurations were investigated: (1) baseline (strakes off), (2) single strake (strake at upper shoulder on port side of boom), and (3) double strake (upper strake plus a lower strake on same side of boom). The strakes were employed as a means to separate airflow over the tail boom and change fuselage yawing moments in a direction to improve the yaw control margin and reduce tail rotor power. Crosswind data were obtained in 5-knot increments of airspeed from 0 to 35 knots and in 30 deg increments of wind azimuth from 0 deg to 330 deg. At the most critical wind azimuth and airspeed in terms of tail rotor power, the strakes improved the pedal margin by 6 percent of total travel and reduced tail rotor power required by 17 percent. The increase in yaw control and reduction in tail rotor power offered by the strakes can expand the helicopter operating envelope in terms of gross weight and altitude capability. The strakes did not affect the flying qualities of the vehicle at airspeeds between 35 and 100 knots. Author

N93-22659# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Abt. fuer Numerische Stroemungsmechanik.
UPWIND RELAXATION METHOD FOR HYPERSONIC FLOW SIMULATION [UPWIND-RELAXATIONSMETHODE FUER DIE SIMULATION VON HYPERSCHALL-STROEMUNGEN]
Bernhard Mueller 25 Sep. 1991 85 p
(DLR-FB-91-36; ETN-93-91925) Avail: CASI HC A05/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Upwind relaxation strategies were developed for space and time marching methods to solve the three dimensional Euler and thin layer Navier-Stokes equations for steady hypersonic flow of perfect gas over pointed and blunt bodies, respectively. The inviscid fluxes are discretized an upwind scheme, and the viscous fluxes are second order central differenced. For pointed bodies, the space marching method iterates the time dependent difference equations to the steady state in crossflow planes starting from a conical solution near the body apex. For blunt bodies, the time marching method employs an alternating planar Gauss-Seidel relaxation in the streamwise direction. Stability and convergence are enhanced by underrelaxing each wave in the crossflow planes individually. The methods are validated for inviscid and laminar hypersonic flows over a 10 deg circular cone and a sphere 15 deg cone. The present space marching method is about one order of magnitude more efficient than the time marching method. ESA

N93-22667 Texas A&M Univ., College Station.
AERODYNAMIC SENSITIVITY ANALYSIS IN THE TRANSONIC REGIME Ph.D. Thesis
Hesham Mahmoud El-Banna 1992 185 p
Avail: Univ. Microfilms Order No. DA9300429

The quasi-analytical approach is developed and applied to the three dimensional full potential equation to compute wing aerodynamic sensitivity coefficients in the transonic regime. Symbolic manipulation is used to reduce the effort associated with obtaining the sensitivity equations, and the large sensitivity system is solved using 'state of the art' routines. Various case studies are conducted and the results are compared to those obtained by the direct finite difference approach. Both methods are evaluated to determine their computational accuracy and efficiency. The quasi-analytical approach is shown to be accurate and efficient for large aerodynamic systems. Dissert. Abstr.

N93-22671*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRUCTURAL DYNAMICS DIVISION RESEARCH AND TECHNOLOGY ACCOMPLISHMENTS FOR FY 1992 AND PLANS FOR FY 1993
Eleanor C. Wynne Washington Jan. 1993 218 p
(RTOP 505-63-50-13)
(NASA-TM-107713; NAS 1.15:107713) Avail: CASI HC A10/MF A03

The purpose of this paper is to present the Structural Dynamics Division's research accomplishments for F.Y. 1992 and research plans for F.Y. 1993. The work under each Branch (technical area) is described in terms of highlights of accomplishments during the past year and highlights of plans for the current year as they relate to 5-year plans for each technical area. This information will be useful in program coordination with other government organizations and industry in areas of mutual interest. Author

N93-22802*# BSA Services, Houston, TX.
HYPERSONIC THREE-DIMENSIONAL NONEQUILIBRIUM BOUNDARY-LAYER EQUATIONS IN GENERALIZED CURVILINEAR COORDINATES
Jong-Hun Lee Feb. 1993 63 p
(Contract NAS9-18493)
(NASA-CR-185677; NAS 1.26:185677) Avail: CASI HC A04/MF A01

The basic governing equations for the second-order three-dimensional hypersonic thermal and chemical nonequilibrium boundary layer are derived by means of an order-of-magnitude analysis. A two-temperature concept is implemented into the system of boundary-layer equations by simplifying the rather complicated general three-temperature thermal gas model. The equations are written in a surface-oriented non-orthogonal curvilinear coordinate system, where two curvilinear coordinates are non-orthogonial and a third coordinate is normal to the surface. The equations are described with minimum use of tensor expressions arising from the coordinate transformation, to avoid unnecessary confusion for readers. The set of equations obtained will be suitable for the development of a three-dimensional nonequilibrium boundary-layer code. Such a code could be used to determine economically the aerodynamic/aerothermodynamic loads to the surfaces of hypersonic vehicles with general configurations. In addition, the basic equations for three-dimensional stagnation flow, of which solution is required as an initial value for space-marching integration of the boundary-layer equations, are given along with the boundary conditions, the boundary-layer parameters, and the inner-outer layer matching procedure. Expressions for the chemical reaction rates and the thermodynamic and transport properties in the thermal nonequilibrium environment are explicitly given. Author

N93-22822*# Akron Univ., OH.
NAVIER-STOKES ANALYSIS OF AIRFOILS WITH LEADING EDGE ICE ACCRETIONS Final Report
Mark G. Potapczuk Feb. 1993 206 p
(Grant NAG3-416; RTOP 505-68-10)
(NASA-CR-191008; E-7580; NAS 1.26:191008) Avail: CASI HC A10/MF A03

A numerical analysis of the flowfield characteristics and the performance degradation of an airfoil with leading edge ice accretions was performed. The important fluid dynamic processes were identified and calculated. Among these were the leading edge separation bubble at low angles of attack, complete separation on the low pressure surface resulting in premature shell, drag rise due to the ice shape, and the effects of angle of attack on the separated flow field. Comparisons to experimental results were conducted to confirm these calculations. A computer code which solves the Navier-Stokes equations in two dimensions, ARC2D, was used to perform the calculations. A Modified Mixing Length turbulence model was developed to produce grids for several ice shape and airfoil combinations. Results indicate that the ability to predict overall performance characteristics, such as lift and drag, at low angles of attack is excellent. Transition location is important for accurately determining separation bubble shape. Details of the flowfield in and downstream of the separated regions requires some modifications. Calculations for the stalled airfoil indicate periodic shedding of vorticity that was generated aft of the ice accretion. Time averaged pressure values produce results which compare favorably with experimental information. A turbulence model which accounts for the history effects in the flow may be justified. Author

N93-22823*# Illinois Univ., Urbana. Dept. of Aeronautical and Astronautical Engineering.
AN EXPERIMENTAL STUDY OF THE AERODYNAMICS OF A NACA0012 AIRFOIL WITH A SIMULATED GLAZE ICE ACCRETION, VOLUME 2 Final Report
Michael B. Bragg Cleveland, OH Mar. 1993 406 p
(Contract NAS3-28; RTOP 505-68-10)
(NASA-CR-191007; E-7690; NAS 1.26:191007) Avail: CASI HC A18/MF A04

This is the second volume of a report documenting the effect of simulated ice accretion on the aerodynamic performance of a NACA 0012 airfoil. Both an experimentally measured and a computer generated ice shape are studied. The purpose of this report is to present the results of the measurements, not an analysis of the data. Surface pressure, integrated lift and pitching moment data are presented as well as drag from a wake

survey. A split hot film probe was used to document the flow-field about the airfoil with simulated ice. Data in the separation bubbles, reattached boundary layer and wake are presented. Both tabulated and graphical data are presented in the paper. The data are also available on computer disk for easy access. Author (revised)

N93-22876*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CHARACTERIZATION OF CAVITY FLOW FIELDS USING PRESSURE DATA OBTAINED IN THE LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL

M. B. Tracy and E. B. Plentovich Washington Mar. 1993 35 p
(RTOP 505-68-70-08)
(NASA-TM-4436; L-17158; NAS 1.15:4436) Avail: CASI HC A03/MF A01

Static and fluctuating pressure distributions were obtained along the floor of a rectangular-box cavity in an experiment performed in the LaRC 0.3-Meter Transonic Cryogenic Tunnel. The cavity studied was 11.25 in. long and 2.50 in. wide with a variable height to obtain length-to-height ratios of 4.4, 6.7, 12.67, and 20.0. The data presented herein were obtained for yaw angles of 0 deg and 15 deg over a Mach number range from 0.2 to 0.9 at a Reynolds number of 30 x 10(exp 6) per ft with a boundary-layer thickness of approximately 0.5 in. The results indicated that open and transitional-open cavity flow supports tone generation at subsonic and transonic speeds at Mach numbers of 0.6 and above. Further, pressure fluctuations associated with acoustic tone generation can be sustained when static pressure distributions indicate that transitional-closed and closed flow fields exist in the cavity. Cavities that support tone generation at 0 deg yaw also supported tone generation at 15 deg yaw when the flow became transitional-closed. For the latter cases, a reduction in tone amplitude was observed. Both static and fluctuating pressure data must be considered when defining cavity flow fields, and the flow models need to be refined to accommodate steady and unsteady flows. Author (revised)

N93-23034*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ATTENUATION OF EMPENNAGE BUFFET RESPONSE THROUGH ACTIVE CONTROL OF DAMPING USING PIEZOELECTRIC MATERIAL

Jennifer Heeg, Jonathan M. Miller (Cornell Univ., Ithaca, NY.), and Robert V. Doggett, Jr. Feb. 1993 17 p Presented at Damping 1993, San Francisco, CA, 24-26 Feb. 1993
(RTOP 590-14-61-01)
(NASA-TM-107736; NAS 1.15:107736) Avail: CASI HC A03/MF A01

Dynamic response and damping data obtained from buffet studies conducted in a low-speed wind tunnel by using a simple, rigid model attached to spring supports are presented. The two parallel leaf spring supports provided a means for the model to respond in a vertical translation mode, thus simulating response in an elastic first bending mode. Wake-induced buffeting flow was created by placing an airfoil upstream of the model of that the wake of the airfoil impinged on the model. Model response was sensed by a strain gage mounted on one of the springs. The output signal from the strain gage was fed back through a control law implemented on a desktop computer. The processed signals were used to 'actuate' a piezoelectric bending actuator bonded to the other spring in such a way as to add damping as the model responded. The results of this 'proof-of-concept' study show that the piezoelectric actuator was effective in attenuating the wake-induced buffet response over the range of parameters investigated. Author

N93-23108*# Pennsylvania State Univ., University Park. Dept. of Meteorology.

MIXED CONVECTIVE/DYNAMIC ROLL VORTICES AND THEIR EFFECTS ON INITIAL WIND AND TEMPERATURE PROFILES

Tracy Haack (National Oceanic and Atmospheric Administration, Washington, DC.) and Hampton N. Shirer Jul. 1991 114 p
(Contract NAG8-780; NAS8-36150)
(NASA-CR-192349; NAS 1.26:192349) Avail: CASI HC A06/MF A02

The onset and development of both dynamically and convectively forced boundary layer rolls are studied with linear and nonlinear analyses of a truncated spectral model of shallow Boussinesq flow. Emphasis is given here on the energetics of the dominant roll modes, on the magnitudes of the roll-induced modifications of the initial basic state wind and temperature profiles, and on the sensitivity of the linear stability results to the use of modified profiles as basic states. It is demonstrated that the roll circulations can produce substantial changes to the cross-roll component of the initial wind profile and that significant changes in orientation angle estimates can result from use of a roll-modified profile in the stability analysis. These results demonstrate that roll contributions must be removed from observed background wind profiles before using them to investigate the mechanisms underlying actual secondary flows in the boundary layer. The model is developed quite generally to accept arbitrary basic state wind profiles as dynamic forcing. An Ekman profile is chosen here merely to provide a means for easy comparison with other theoretical boundary layer studies; the ultimate application of the model is to study observed boundary layer profiles. Results of the analytic stability analysis are validated by comparing them with results from a larger linear model. For an appropriate Ekman depth, a complete set of transition curves is given in forcing parameter space for roll modes driven both thermally and dynamically. Preferred orientation angles, horizontal wavelengths and propagation frequencies, as well as energetics and wind profile modifications, are all shown to agree rather well with results from studies on Ekman layers as well as with studies on near-neutral and convective atmospheric boundary layers.
Author

N93-23203 Rice Univ., Houston, TX.

OPTIMIZATION OF FLIGHT TRAJECTORIES IN A 3D MODEL OF WINDSHEAR FLOW FIELD Ph.D. Thesis

Hoo Wang 1992 109 p
Avail: Univ. Microfilms Order No. DA9234375

This thesis is concerned with the optimal flight trajectories in the presence of a three-dimensional windshear. Both the take-off and abort landing problems are studied. A mathematical model of a three-dimensional windshear is developed by the superposition of the flow fields of two symmetric vortex rings with appropriate parameters (circulation strength, radius, height). The flow field produced by this vortex ring pair is close to that of a real microburst. The wind components are functions of the geometric coordinates and can be obtained using either Biot-Savart law or the properties of the stream function. With this wind model, the strongest windshear and downdraft are located in a vertical plane passing through the central axis of the vortex ring pair. Therefore, in the computation of flight trajectories, the aircraft is assumed to fly in this vertical plane. Two cases are considered: (1) at the initial time, the aircraft is located in the region of strongest headwind; (2) at the initial time, the aircraft is located in the region of weak-to-moderate headwind. Case 1 implies late detection, while case 2 implies early detection of windshear. Optimal trajectories are computed for both take-off and abort landing. For the take-off problem, the performance index being minimized is the peak value of the deviation of the absolute path inclination from a reference value; for the abort landing problem, the performance index being minimized is the peak value of the altitude drop. The resulting optimal control problems are Chebyshev problems, which are converted into Bolza problems via suitable transformations. Then, the Bolza problems are solved by using the sequential gradient-restoration algorithm (SGRA). Numerical computations for both the take-off and abort landing problems lead to the following conclusions: (1) The survival capability of the optimal trajectory is superior to that of the constant pitch trajectory and the maximum angle of attack trajectory; this means that near-optimal guidance schemes should be developed to improve the survival capability of an aircraft in a severe windshear. (2) For the optimal trajectories, the survival capability in Case 2 (early detection) is superior to that in Case 1 (late detection); this indicates that early detection of a windshear can ehnace the safety of flight. Dissert. Abstr.

N93-23364# Aeritalia S.p.A., Pomigliano D'Arco (Italy). Gruppo Aerei da Trasporto.

A SYSTEM FOR THE NUMERICAL SIMULATION OF COMPLEX CONFIGURATION INTERNAL AERODYNAMIC FIELDS FOR THE AEROSPACE INDUSTRY [UN SISTEMA PER LA SIMULAZIONE NUMERICA DI CAMPI AERODINAMICA INTORNO A CONFIGURAZIONI COMPLESSE PER L'INDUSTRIA AEROSPAZIALE]

A. Amendola and R. Tognaccini 1991 31 p In ITALIAN
(ETN-93-93698) Avail: CASI HC A03/MF A01

An outline for a system to simulate aerodynamic flow distribution for complex configurations is presented. The objectives of computational fluid dynamics in the aerospace industry are outlined. The computation method

is based on Navier-Stokes and Euler equations of motion. A software for the analysis of complex aerodynamics configurations and future developments are shown. (The presentation is in the form of overhead projector graphics). ESA

N93-23392*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.

NUMERICAL PREDICTION OF TRANSITION OF THE F-16 WING AT SUPERSONIC SPEEDS Final Report

Russell M. Cummings Mar. 1993 3 p

(Contract NCC2-754)

(NASA-CR-192706; NAS 1.26:192706) Avail: CASI HC A01/MF A01

This work is part of the high speed research program currently underway at NASA. This project has the goal of gaining understanding of the technical requirements for supersonic-hypersonic flight. Specifically, this research is part of a continuing project to study the laminar flow over swept wings at high speeds and involves the numerical prediction of the flow about the F-16XL wing. The research uses the CNS/ARC3D codes and the resulting crossflow velocity components in order to estimate transition locations on the wing. Effects of angle of attack on the extent of laminar flows was found to be minimal. This result can be attributed to the fact that a laminar flow airfoil was used in this study, which has a continuous favorable pressure gradient over approximately the first 20 percent of the chord for angles of attacks up to 10 degrees. It should also be noted that even after 20 percent chord the pressure gradient either slowly continued to increase, but never decreased before 90 percent chord, except for the higher swept cases when separation occurs. Angles of attack greater than 10 degrees were not considered since this study assumes natural laminar flow for normal supersonic cruise flight conditions. Derived from text

N93-23399*# Illinois Univ., Urbana.

A STUDY OF THE ACCURACY OF NEUTRALLY BUOYANT BUBBLES USED AS FLOW TRACERS IN AIR

Michael F. Kerho Cleveland, OH Mar. 1993 82 p Original contains color illustrations

(Grant NAG3-1134; RTOP 505-68-10)

(NASA-CR-191088; E-7630; NAS 1.26:191088) Avail: CASI HC A05/MF A01; 4 functional color pages

Research has been performed to determine the accuracy of neutrally buoyant and near neutrally buoyant bubbles used as flow tracers in air. Theoretical, computational, and experimental results are presented to evaluate the dynamics of bubble trajectories and factors affecting their ability to trace flow-field streamlines. The equation of motion for a single bubble was obtained and evaluated using a computational scheme to determine the factors which affect a bubble's trajectory. A two-dimensional experiment was also conducted to experimentally determine bubble trajectories in the stagnation region of NACA 0012 airfoil at 0 deg angle of attack using a commercially available helium bubble generation system. Physical properties of the experimental bubble trajectories were estimated using the computational scheme. These properties included the density ratio and diameter of the individual bubbles. the helium bubble system was then used to visualize and document the flow field about a 30 deg swept semispan wing with simulated glaze ice. Results were compared to Navier-Stokes calculations and surface oil flow visualization. The theoretical and computational analysis have shown that neutrally buoyant bubbles will trace even the most complex flow patterns. Experimental analysis revealed that the use of bubbles to trace flow patterns should be limited to qualitative measurements unless care is taken to ensure neutral buoyancy. This is due to the difficulty in the production of neutrally buoyant bubbles. Author (revised)

N93-23422*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

AN OVERVIEW OF AEROELASTICITY STUDIES FOR THE NATIONAL AEROSPACE PLANE

Rodney H. Ricketts, Thomas E. Noll, Lawrence J. Huttsell, and Lawrence J. Hutsell Mar. 1993 13 p Presented at the AIAA 34th SDM Conference, 19-23 Apr. 1993

(RTOP 763-23-41)

(NASA-TM-107728; NAS 1.15:107728) Avail: CASI HC A03/MF A01

The National Aero-Space Plane (NASP), or X-30, is a single-stage-to-orbit vehicle that is designed to takeoff and land on conventional runways. Research in aeroelasticity was conducted by NASA and the Wright Laboratory to support the design of a flight vehicle by the national contractor team. This research includes the development of new computational codes for predicting unsteady aerodynamic pressures. In addition, studies were conducted to determine the aerodynamic heating effects on vehicle aeroelasticity and to determine the effects of fuselage flexibility on the stability of the control systems. It also includes the testing of scale models to better understand the aeroelastic behavior of the X-30 and to obtain data for code validation and correlation. This paper presents an overview of the aeroelastic research which has been conducted to support the airframe design. Author (revised)

N93-23431*# Sverdrup Technology, Inc., Brook Park, OH.

UNSTEADY BLADE PRESSURES ON A PROPFAN: PREDICTED AND MEASURED COMPRESSIBILITY EFFECTS Final Report

M. Nallasamy Jul. 1992 16 p Presented at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE Original contains color illustrations

(Contract NAS3-25266; RTOP 535-03-10)

(NASA-CR-191087; E-7631; NAS 1.26:191087) Avail: CASI HC A03/MF A01; 2 functional color pages

The effect of compressibility on unsteady blade pressures is studied by solving the three-dimensional Euler equations. The operation of the eight-bladed SR7L propfan at a 4.75 deg angle of attack was considered. Euler solutions were obtained for three Mach numbers, 0.6, 0.7 and 0.8, and the predicted blade pressure waveforms were compared with flight data. The comparisons show that in general, the effect of Mach number on pressure waveforms are correctly predicted. The change in pressure waveforms are minimal when the Mach number is increased from 0.6 to 0.7. Increasing the Mach number from 0.7 to 0.8 produces significant changes in predicted pressure levels. The predicted amplitudes, however, differ from measurements at some transducer locations. At all the three Mach numbers, the measured (installed propfan) pressure waveforms show a relative phase lag compared to the computed (propfan along) waveforms due to installation effects. Measured waveforms in the blade tip region show nonlinear variations which are not captured by the present numerical procedure. Author (revised)

N93-23476# California Univ., Irvine. Combustion Lab.

TRANSVERSE INJECTION OF LIQUID AND GASEOUS FUELS INTO SUBSONIC/SUPERSONIC FLOW Final Report, Sep. 1988 - Dec. 1991

D. Papamoschou, W. A. Sirignano, and G. S. Samuelsen May 1992 81 p

(Contract F33615-88-C-2889)

(AD-A259771; UCI-ARTR-92-2; WL-TR-92-2046) Avail: CASI HC A05/MF A01

The goal of the program was to provide needed insight into the mixing behavior of liquid and gaseous jets injected transversely into a high velocity crossflow. The penetration of round supersonic jets normal to a supersonic cross flow was studied experimentally in a specially configured supersonic wind tunnel. The cross-flow stream consisted of air at Mach numbers of 2 and 3. The jet Mach number ranged from 1 to 3.53 and the jet gases employed were helium and argon. Schieren photography was the primary diagnostic. The effects of jet-to-freestream momentum ratio, jet and freestream Mach numbers, and pressure and density ratios at the jet exit were examined. It is found that penetration is strongly dependent on momentum ratio, weakly dependent on Mach numbers and pressure ratio, and independent of density ratio. For fixed momentum ratio, increasing freestream Mach number produced a small increase in penetration, while changing the jet Mach number produced no apparent effect. Values of pressure ratio that appear to maximize penetration are suggested. Flow visualization reveals large-scale turbulent structures in the jet and significant steadiness of the bow shock in front of the jet. GRA

N93-23489 Ohio State Univ., Columbus.

TIP-VORTEX/AIRFRAME INTERACTIONS Ph.D. Thesis

Habib Affes 1992 297 p

Avail: Univ. Microfilms Order No. DA9238117

The flow field generated by a helicopter in flight is extremely complex and it has been recognized that interactions between different components can significantly affect helicopter performance. In particular, the effects of the interaction between the rotor wake, which consists of a highly

three-dimensional helical vortex sheet and a high-strength tip-vortex, and the helicopter fuselage are extremely difficult to predict and pose a challenging problem for researchers and designers in the rotorcraft area. In the present work, the unsteady interaction of the rotor tip-vortex with the fuselage and the problem of the three-dimensional boundary-layer so generated on the fuselage underneath the vortex are investigated. In the first phase of the present work, a simplified model for the interaction of a rotor-tip-vortex with a fuselage or airframe is developed using three-dimensional potential flow analysis. The tip-vortex is idealized as a single three-dimensional vortex filament and the fuselage is modeled by an infinitely long circular cylinder. The Biot-Savart law is employed to describe the flow induced by the vortex and the flow is assumed to be inviscid and irrotational outside of the core of the vortex. The present analytical/numerical results for both the vortex trajectory and the pressure distribution on the airframe are in substantial agreement with experimental results prior to impact of the vortex with the airframe. The numerical calculations indicate that a large adverse pressure gradient develops under the vortex on the fuselage causing a rapid drop in the pressure there. The second phase of the present work focuses on the problem of the unsteady three-dimensional boundary-layer flow induced by the vortex filament moving above the fuselage. Three types of external flow in which the vortex is embedded are considered. These flows are respectively a stagnant medium, a symmetric mean flow and an asymmetric mean flow, the latter of which corresponds to the experimental conditions described above. In each case, the computed results show the development of a variety of complex three-dimensional boundary-layer separation phenomena. In all cases, the boundary-layer solutions show for formation of a secondary eddy which grows in time; this situation is expected to lead to an eruption of boundary-layer fluid into the free stream. The secondary eddy initially starts from a bubble-like shape of swirling flow and then evolves into a more complex structure; in particular, in the symmetric mean flow case, the secondary eddy evolves and grows in time and resembles the initiation of a horseshoe type vortex. Dissert. Abstr.

N93-23589 Washington State Univ., Pullman.
ACTIVE CONTROL OF THE SEPARATION REGION ON A TWO-DIMENSIONAL AIRFOIL Ph.D. Thesis
Julie Anne Lovato 1992 148 p
Avail: Univ. Microfilms Order No. DA9238408

The effectiveness of combat aircraft depends in part on their ability to maintain high lift under extreme conditions. Examples of such conditions include the high angle of attack, rapid pitch motions necessary for combat maneuvers. A well known phenomenon occurring on airfoils undergoing such high angle of attack motions is the formation of a leading edge vortex. This vortex is preceded by significant increases in lift, but is also accompanied by subsequent rapid loss of lift and the ensuing dynamic stall. Prior to dynamic stall vortex formation, the unsteady separating boundary layer resembles the separating boundary layer over a static airfoil. Before developing control methodologies for unsteady flows, it is necessary to obtain a thorough understanding of the controlled flow over a static airfoil. This experimental analysis presents a comprehensive study of the separating boundary layer over a static airfoil under natural and actively controlled conditions. Near-surface hot-film and surface pressure measurements, as well as flow visualization are used to analyze the large-scale nature of the flow and determine forcing effects. Results from the static study are then extended for an initial evaluation of unsteady airfoil control. The fundamental frequency for a two-dimensional NACA-0015 airfoil is found to be an integral multiple of the frequency associated with wake structures. The static separating boundary layer response to active control confirms that it is a boundary layer transitioning to a free shear layer. Qualitative analyses show that significant reduction in overall static separation can be achieved under forcing conditions. Upper airfoil surface suction values are also significantly increased over the natural values. Applying tangential pulsed air control at static fundamental frequencies to a dynamic airfoil results in delay of the dynamic stall vortex formation and a delay of dynamic stall. These discoveries indicate that the developed control methodology may prove successful in increasing unsteady aircraft maneuverability. Dissert. Abstr.

N93-23594 Rensselaer Polytechnic Inst., Troy, NY.
ASYMPTOTIC ANALYSIS OF: 1: WAVE PROPAGATION IN DISPERSIVE OPTICAL MEDIA WITH QUADRATIC NONLINEARITY. 2: A HYPERSONIC WING WITH THREE-DIMENSIONAL SELF-SIMILARITY Ph.D. Thesis
Andre Gabor Kalocsai 1992 134 p
Avail: Univ. Microfilms Order No. DA9236227

An asymptotic analysis is presented for two distinct and independent problems: (1) Wave propagation in dispersive optical media with quadratic nonlinearity; and (2) Hypersonic flows with three dimensional self-similarity. Asymptotic methods are useful for physical problems with small parameters in that the dominant physical process may be extracted from various parameter regimes that result in a simplified self-consistent mathematical analysis. The asymptotic method used depends critically upon the physical problem. In the optics problem, we at first study single and multiple input propagating waves at frequencies away from dielectric resonances. Here we compare the Slowly Varying Envelope Approximation to the Method of Multiple Scales and show that the Method of Multiple Scales is a superior technique that can be applied self consistently to any perturbation order which in turn predicts new physical effects. For the singly slowly modulated input wave problem, under appropriate conditions, we show that at the O(epsilon squared) perturbation, we obtain the cubic nonlinear Schrodinger equation. This means that for the single input wave propagating in a quadratic nonlinear medium, self-modulation effects and soliton behavior may be observed depending on the boundary conditions. For the problem with two input waves without phase matching, typical cross phase modulation equations are derived which are coupled cubic nonlinear Schrodinger equations. When two input waves have good phase matching, different asymptotic equations are obtained and illustrated such as the usual second harmonic generation problem which is a degenerate three wave mixing problem. For the single input wave near a classical dielectric resonance, we find that the wave number becomes amplitude dependent. The method of multiple scales is replaced by Whitham's averaged Lagrangian. We derive the associated modulated envelope equations. We investigate an effective medium regime and the full nonlinear problem. The hypersonic flow problem requires the use of asymptotic matching that arises from the geometry from the problem. Here the pressure field and lift to drag ratio C(sub L)(sup 3/2)/C(sub D) is evaluated for a wide delta wing with small power law curvature. Use is made of Hypersonic Small Disturbance Theory and three dimensional power law similarity. It is shown that an improvement for C(sub L)(sup 3/2)/C(sub D) occurs for wings with power law curvatures greater than one, when compared to flat delta wings. This improvement in performance agrees qualitatively with other types of concave wings.
Dissert. Abstr.

N93-23654# Army Natick Research and Development Command, MA.
A NONLINEAR DYNAMIC SPHERICAL MEMBRANE MODEL Final Report, Aug. 1991 - Jul. 1992
Richard J. Benney Jan. 1993 125 p
(DA Proj. 1L1-62786-D-283)
(AD-A259633; NATICK-TR-93/017) Avail: CASI HC A06/MF A02

A static set of nonlinear spherical membrane equations are modified to model the dynamic response of a spherical membrane to a time dependent pressure distribution. The two governing partial differential equations (PSE's) were converted into a system of nonlinear first order differential equations which are finite differenced in space and solved numerically. The model is a first step towards modeling the dynamic response of parachutes during the complex opening phase. The ultimate end use for a numerical structural dynamic canopy model is to couple it with a numerical model of the fluid medium surrounding the canopy. The project involves coupling the computational fluid dynamics (CFD) code SALE (Simplified Arbitrary Lagrangian Eulerian) to a modified version of the spherical membrane model FORTRAN programs described in this report. The spherical membrane model coupled to the CFD code SALE will be a major step towards the solution of the opening problem of parachutes. The solution of the opening problem will provide essential information to aid in the design of high-speed, low-altitude airdrop systems. GRA

N93-23714# Florida Agricultural and Mechanical Univ., Tallahassee. Fluid Mechanics Research Lab.

UNSTEADY FLOW PAST A PITCHING AIRFOIL AT MODERATELY HIGH SUBSONIC FREE STREAM MACH NUMBERS Final Report, 1 Jun. 1989 - 31 May 1992

A. Krothapalli, G. Buzyna, and L. Lourenco 26 Oct. 1992 60 p
(Contract F49620-89-C-0067)
(AD-A260118; FMRL-TR-7; AFOSR-92-1011TR) Avail: CASI HC A04/MF A01

An experimental and computational investigation was carried out to study the flow past a NACA 0012 airfoil undergoing pitch up motion at free Mach numbers ranging 0.3 to 0.8. The flow velocity field was captured using PIV demonstrating the ability of the technique to characterize high speed separated flows. A companion computational study was conducted to assess the effect of wind tunnel walls on the dynamic stall process. GRA

N93-24058*# Continuum Dynamics, Inc., Princeton, NJ.

COMPUTATION OF ROTOR AERODYNAMIC LOADS IN FORWARD FLIGHT USING A FULL-SPAN FREE WAKE ANALYSIS

Todd R. Quackenbush, Donald B. Bliss, Daniel A. Wachspress, Alexander H. Boschitsch, and Kiat Chua Oct. 1990 139 p
(Contract NAS2-13838; RTOP 505-59-36)
(NASA-CR-177611; A-91136; NAS 1.26:177611) Avail: CASI HC A07/MF A02

The development of an advanced computational analysis of unsteady aerodynamic loads on isolated helicopter rotors in forward flight is described. The primary technical focus of the development was the implementation of a freely distorting filamentary wake model composed of curved vortex elements laid out along contours of constant vortex sheet strength in the wake. This model captures the wake generated by the full span of each rotor blade and makes possible a unified treatment of the shed and trailed vorticity in the wake. This wake model was coupled to a modal analysis of the rotor blade dynamics and a vortex lattice treatment of the aerodynamic loads to produce a comprehensive model for rotor performance and air loads in forward flight dubbed RotorCRAFT (Computation of Rotor Aerodynamics in Forward Flight). The technical background on the major components of this analysis are discussed and the correlation of predictions of performance, trim, and unsteady air loads with experimental data from several representative rotor configurations is examined. The primary conclusions of this study are that the RotorCRAFT analysis correlates well with measured loads on a variety of configurations and that application of the full span free wake model is required to capture several important features of the vibratory loading on rotor blades in forward flight. Author

N93-24111*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SLOTTED-WALL FLOW-FIELD MEASUREMENTS IN A TRANSONIC WIND TUNNEL (Diskette Supplement)

Joel L. Everhart, William B. Igoe, and Stuart G. Flechner Washington Aug. 1991 110 p, Diskette supplement: IBM compatible 3.5-inch diskette in ASCII format
(RTOP 506-40-41-02)
(NASA-TM-4280; L-16865; NAS 1.15:4280; NONP-Suppl-DK-93-153709)
Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A13

Flowfield measurements obtained on the normal centerplane passing through a longitudinal slot in the wall of a transonic wind tunnel are presented. Data were acquired with a three-tube flow-angle probe, and distribution of flow angle, Mach number, and total pressure are given for free stream Mach numbers from 4.0 to 0.85. Cases are presented for tunnel empty and with a NACA 0012-64 airfoil model installed. Mass flow through the slot was varied by plenum suction over a range of 0 to 2 percent of the free-stream mass flow. The data are presented without analysis. The run schedule which details specific test conditions for each run is given in an appendix. A tabular listing of the data organized by run number is presented in a second appendix and is also provided on an IBM PC compatible 3.5-in. floppy disk in ASCII format. Author (revised)

N93-24118*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ANALYTICAL AND EXPERIMENTAL STUDIES OF A SHORT COMPACT SUBSONIC DIFFUSER FOR A TWO-DIMENSIONAL SUPERSONIC INLET

Chanthy Iek, Richard R. Burley, and Albert L. Johns Mar. 1993 65 p
(RTOP 505-62-71)
(NASA-TP-3247; E-7111; NAS 1.60:3247) Avail: CASI HC A04/MF A01

An experimental study of a two-dimensional supersonic inlet with a short compact subsonic diffuser, length to exit diameter (dl/d) ratio of 1.25, was conducted to investigate the impact of the short diffuser on inlet performance at low speeds and to assess the diffuser subsonic performance for a simulated diffuser flow corresponding to high-speed inlet conditions near the design flight Mach number of 2.2. For the low-speed testing, a drooped lip was employed to improve the inlet performance at a high angle of attack. For the simulated high-speed testing, air was blown through slots or discrete nozzles as an active boundary-layer control. The results from the low-speed performance test were compared with the results from a previous test program on the same inlet with a long subsonic diffuser (dl/d = 4.5). The comparison indicates that inlet recovery was not affected by the use of the short diffuser for either the baseline (no droop) or the drooped cowl lip configuration. However, the inlet baseline distortion for the short diffuser configuration was substantially higher than for the long diffuser. A comparison of the two configurations with a 70 deg drooped lip showed no significant difference in distortion. For the portion of the experimental program in which diffuser conditions for high-speed flight were simulated, diffuser-induced flow separation occurred. This separation was predicted from an analytical study that used the Hess potential flow panel method and the Herring two-dimensional boundary-layer analysis computer codes. The flow separated mainly on the diffuser ramp. Subsequent tests in which boundary-control systems were utilized showed that blowing with either slots or discrete nozzles could suppress the flow separation in the short subsonic diffuser, thereby substantially improving the diffuser performance. Author (revised)

N93-24136 Old Dominion Univ., Norfolk, VA.

UNSTEADY EULER AND NAVIER-STOKES COMPUTATIONS AROUND OSCILLATING DELTA WING INCLUDING DYNAMICS Ph.D. Thesis

Ahmed Abd-El-Bar Ahm Salman 1992 264 p
Avail: Univ. Microfilms Order No. DA9230211

Unsteady flows around rigid or flexible delta wings with and without oscillating leading-edge flaps are considered. These unsteady flow problems are categorized under two classes of problems. In the first class, the wing motion is prescribed a priori and in the second class, the wing motion is obtained as a part of the solution. The formulation of the first class includes either the unsteady Euler or unsteady Navier-Stokes equations for the fluid dynamics and the unsteady linearized Navier-displacement (ND) equations for the grid deformation. The problem of unsteady transonic flow past a bicircular-arc airfoil undergoing prescribed thickening-thinning oscillation is studied using the CFL2D code. This code is used to solve the Navier-Stokes equations using an implicit, flux-difference splitting, finite-volume scheme. For the unsteady supersonic flows around flexible delta wings with prescribed oscillating deformation and rigid delta wings with leading-edge-flap oscillations, the conservative, unsteady Euler and thin-layer Navier-Stokes equations in a moving frame-of-reference, along with the linearized ND equations, have been used. Two main problems are solved to demonstrate the validity of the developed schemes. The first problem is that of a flexible delta wing undergoing a prescribed bending-mode oscillation. In the second problem, a rigid-delta wing with symmetric and anti-symmetric flap oscillations is considered. These applications fall under the first class of problems. For the unsteady flow applications, where the wing motion is not prescribed a priori (second class of problems), either the unsteady Euler or thin-layer Navier-Stokes equations and the rigid-body dynamics equations, in a moving frame of reference, are solved sequentially to obtain the flow behavior and the wing motion. The main application for this class of unsteady flow phenomena, is the wing-rock problem. Using the locally-conical flow assumption, three problems are solved. The first is that of a delta wing undergoing a damped rolling oscillation. The second is that of a delta wing undergoing a limit-cycle, wing-rock motion. In the third problem, suppression of the wing-rock motion is demonstrated using a tuned anti-symmetric oscillation of the leading-edge flaps.

Dissert. Abstr.

N93-24209 Texas Univ., Austin.
AN EXPERIMENTAL STUDY OF THE DRIVING MECHANISM AND CONTROL OF THE UNSTEADY SHOCK-INDUCED TURBULENT SEPARATION IN A MACH 5 COMPRESSION CORNER FLOW Ph.D. Thesis
William Berton McClure 1992 276 p
Avail: Univ. Microfilms Order No. DA9239313

This experimental study has examined the unsteady flowfield associated with the shock-induced separation of a turbulent boundary layer. The interaction was generated by a 28 deg unswept compression corner in a Mach 5 airstream. Perturbations were made to the interaction to better understand the mechanism responsible for the separation shock dynamics, as well as to demonstrate a method of controlling the shock motion. Local motion of the separation shock is associated with a characteristic signature in the wall pressure fluctuations beneath the incoming turbulent boundary layer. The shape of this signature is dependent only on whether the local shock motion is upstream or downstream. Fluctuating pitot pressure measurements made within the incoming boundary layer indicate that the maximum boundary layer interface crossing frequency is about five times that of the maximum separation shock zero crossing frequency. Power spectra from these pitot pressure data exhibit an increased role of low frequency (less than 2 kHz) fluctuations in the overall variance of the signal. This frequency range closely matches the dominant frequencies found in wall pressure fluctuations beneath the separation shock. Such fluctuations are not evident in the wall pressure or freestream pitot pressure measurements taken upstream of the interaction. Motion and location of the separated shear layer is found to be correlated with that of the separation shock such that the overall separation bubble exhibits a 'breathing' motion. As shown for the first time from the results of this study, the motion of the downstream limit of this bubble predominantly lags that of the upstream limit, independent of the direction of the bubble motion (inflating or collapsing). Motion of both the separation shock and shear layer seem to be secondary responses to primary, but undetermined, changes to the flowfield. Evidence of the shear layer motion is found at least as far downstream as 3.5 times the thickness of the incoming turbulent boundary layer. In all, these data suggest that the separation shock motion and associated flowfield unsteadiness is primarily driven by fluctuations in the outer two-thirds of the incoming turbulent boundary layer. Dissert. Abstr.

N93-24215 Texas Univ., Austin.
THE EFFECT OF LARGE-SCALE UNSTEADY MOTION ON A TURBULENT REATTACHING SHEAR LAYER: APPLICATION TO THE SUPERSONIC COMPRESSION RAMP Ph.D. Thesis
Martin Joseph Guillot 1992 210 p
Avail: Univ. Microfilms Order No. DA9239262

A phenomenological model is developed to simulate the effect of large-scale unsteadiness which develops in a supersonic reattaching shear layer. The effect of the unsteadiness, predicted by the model, upon the mean flowfield in the reattachment region of a supersonic compression ramp, where flow separation and subsequent reattachment occurs, is then investigated. A triple decomposition is performed on the governing equations. The instantaneous values of velocity and pressure are decomposed into lower frequency, quasi-periodic fluctuations, higher frequency, random turbulent fluctuations, and mean components. The equations are 'short' time averaged over a time interval long enough to average the higher frequency fluctuations, but short enough so that the lower frequency fluctuations may be approximated as constant over the interval. The resulting equations are then separated into time-dependent and time-independent equations. However, since this study is primarily concerned with investigating the possible causes of the rapid acceleration of the inner region of the boundary layer downstream of reattachment, and it is believed that this is primarily due to the large-scale velocity and pressure fluctuations, lower frequency fluctuations of temperature are not considered. Furthermore, the so called Morkovin hypothesis is invoked for the small-scale, higher frequency random turbulence, so that density fluctuations are not considered. Therefore, the small scale turbulence is modeled with a zero-equation incompressible turbulence model. After time averaging, time-independent equations result which contain the usual Reynolds stresses, plus additional 'source' terms due to the large-scale unsteadiness. Additionally, a time-dependent momentum equation is obtained which describes the large-scale unsteadiness. The phenomenological model appears as a velocity boundary condition and a forcing function to this equation. An approximate form of the time-dependent equation is solved and analytical solutions are found that are used to calculate the 'source' terms in the time-independent equations. It is shown that by including the effect of the large-scale unsteadiness, improved predictions of experimental values are obtained. Furthermore, this provides a possible explanation for the rapid acceleration of the inner region of the boundary layer downstream of reattachment.
Dissert. Abstr.

N93-24224# United Technologies Research Center, East Hartford, CT.
AN OSCILLATING THREE-DIMENSIONAL WING EXPERIMENT: COMPRESSIBILITY, SWEEP, RATE, WAVEFORM, AND GEOMETRY EFFECTS ON UNSTEADY SEPARATION AND DYNAMIC STALL Final Report, Apr. 1989 - Nov. 1992
Peter F. Lorber, Franklin O. Carta, and Alfred F. Covino, Jr. 30 Nov. 1992 187 p
(Contract DAAL03-89-C-0013)
(AD-A260530; UTRC/R92-958325-6; ARO-26631.8-EG) Avail: CASI HC A09/MF A02

Experimental measurements of the unsteady separation and dynamic stall process on an oscillating three-dimensional wing are reported. The experiment was conducted at Mach numbers of 0.2-0.6, Reynolds numbers of 2-6 million, and sweep angles of 0, 15, and 30 deg. At low Mach number, as angle of attack is increased the location of transition to turbulence moves forward, the turbulent boundary layer separates near the leading edge, and a strong stall vortex is formed. At higher Mach number, compressibility causes formation of a shock, an earlier, more gradual separation, and reduced unsteady loads. Unsteady tip loads at 0 sweep are increased by the growth of a strong tip vortex. This effect is lessened by sweep-back and compressibility, and enhanced by replacing the round tip cap with a flat tip. Away from the tip, sweep effects on loads are well represented by the swept infinite wing normalization until stall. After stall, vortex propagation patterns are highly dependent on sweep and spanwise position. Sinusoidal and constant pitch rate ramp motions show similar behavior. There is significant hysteresis in both the transition/relaminarization and the separation/reattachment processes. For small amplitude motions simulating stall flutter, substantial regions of negative aerodynamic damping were found -at all studied Mach numbers, sweep angles, and reduced frequencies. The near-simultaneous stall along the span of the swept wing strengthens the resulting instability. An empirical representation of the damping characteristics was developed. GRA

N93-24263# Grumman Aerospace Corp., Bethpage, NY.
AN INVESTIGATION OF THE FUNDAMENTAL CAUSE OF ASYMMETRIC SEPARATED FLOW Final Report, 1 Apr. 1991 - 30 Jun. 1992
F. Marconi Oct. 1992 49 p
(Contract DAAL03-91-C-0013)
(AD-A260296; ARO-28252.1-EG) Avail: CASI HC A03/MF A01

The cause of the phenomenon of steady asymmetric flow on cones at moderately high angles of attack is discussed. At very high angles of attack, the flow will become unsteady with a Karman vortex street being shed downstream. This second phenomenon was not considered. The investigation used computational fluid dynamics as a tool to uncover the fundamental cause of asymmetric separated flows. The appearance of new flow features as the critical angle of attack was approached was studied in detail. Isolating asymmetric disturbances to specific portions of the flow was also attempted. The stability of the symmetric flow above the critical angle of attack was investigated analytically. The transition of the flow from symmetric to asymmetric as the computation was continued was studied in detail. All of these studies indicated that the interaction of the vortices in the cross flow plane results in an instability in the symmetric flow. In addition, the interaction between the vortices seems to be somewhat global in nature. GRA

N93-24475*# Eloret Corp., Moffett Field, CA.
INVESTIGATION OF AEROTHERMODYNAMICS AND OPTICAL RADIATION IN THE AFE HYPERSONIC FLOW FIELD Final Technical Report, 1 Dec. 1989 - 31 Jan. 1993
Giusseppe Palumbo, Roger A. Craig, and William C. Davy 16 Mar. 1993 24 p

(Contract NCC2-653)
(NASA-CR-192844; NAS 1.26:192844) Avail: CASI HC A03/MF A01

Research for the radiation experiments on the Aeroassist Flight Experiment (AFE) was performed to obtain a data base for development of engineering requirements for aerobrakes. Due to funding restrictions, the necessary Aerobrake design data were obtained from ground based experiments, specifically arc-jet wind tunnels. Except for the instrument windows, final development of the AFE radiometers was completed. Window definition included several designs to be flight validated in arc-jets. This work was completed, and successful designs have evolved which will yield full scientific return from the flight experiment. The theoretical work includes final code development to describe the spacecraft environment to support instrument definition, optical radiation codes that operate at significantly improved speeds, and calculation of radiation forebody loads and effects on experiment objectives for varying AFE weights and trajectories. Furthermore, radiant flux vectors at the AFE base were predicted to be used for afterbody instrument definition. The Vacuum Ultraviolet Experiment for the Arc-Jet was completed, and arc-jet experiment conditions and experiment objectives were refined to incorporate the most current thinking. Ballistic range experiments were completed. Several shadowgraphs indicating corner turning angles and waviness structures were obtained, and the results were used to estimate the compression region location for the AFE flight. The waviness measured has helped to model the temporal variations of wake radiation for purposes of defining radiometers to measure the energy content of wake dynamics. Author (revised)

N93-24508# National Aerospace Lab., Tokyo (Japan).
LOW-SPEED WIND TUNNEL STUDY OF THE DIRECT LIFT AND DIRECT SIDE-FORCE CHARACTERISTICS OF A JOINED-WING AIRPLANE
T. Fujita, A. Iwasaki, H. Fujieda, and N. Takizawa Mar. 1992 29 p
(DE93-767971; NAL-TR-1142) Avail: CASI HC A03/MF A01

A diamond joined-wing airplane having wings with a sweepback angle and a dihedral angle linked with horizontal tails (rear wings) with a sweepforward angle and a cathedral angle can control lift and side force directly by operating combinedly the wing fins and the horizontal tail fins. If this control method can be used in an aircraft making a low-speed landing in a sudden gust or side-wind condition, the safety could be improved largely. This paper describes a low-speed wind tunnel test carried out on diamond joined-wing airplane models in four variations each having different area ratio between horizontal tails and wings. The experiment was conducted with the model plane fitted on three balance stanchions in the wind tunnel and subjected to a test wind velocity of 30 m/s. Investigations were given on the effect of the area of the fins and the horizontal tails on directly controlling the lift and side force. As a result, it was verified that the lift and side force can be controlled by operating properly each fin on the wings and the horizontal tails. DOE

N93-24524*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INFLOW MEASUREMENTS MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 8: RECTANGULAR PLANFORM BLADES AT AN ADVANCE RATIO OF 0.23, 0.50 CHORD ABOVE THE TIP PATH PLANE (Diskette Supplement)
Susan L. Althoff (Army Aviation Systems Command, Hampton, VA.), Joe W. Elliott (Army Aviation Systems Command, Hampton, VA.), Danny R. Hoad (Army Aviation Systems Command, Hampton, VA.), and Richard H. Sailey (Lockheed Engineering and Sciences Co., Hampton, VA.) May 1990 389 p Diskette supplement: 2 IBM compatible 5.25-inch DSDD diskettes Original contains color illustrations
(RTOP 505-61-51-10)
(NASA-TM-102642; NAS 1.15:102642; AVSCOM-TM-90-B-007-Vol-8; NONP-Suppl-DK-93-159787) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A22; 2 functional color pages

An experimental investigation was conducted in the 14- by 22-Foot Supersonic Tunnel at the NASA Langley Research Center to measure the inflow into a scale model helicopter rotor in forward flight (mu = 0.23). The measurements were made with a two-component Laser Velocimeter (LV) 0.50 chord above the plane formed by the path of the rotor tips (tip-path-plane). A conditional sampling technique was employed to determine the position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 178 separate locations in order to clearly define the inflow character. The mean and standard deviation of the induced inflow ratios and the azimuthally dependent induced inflow ratios are included on 5.25 flexible disk in the pocket on the inside of the rear cover of this report. These data are presented without analysis. Author

N93-24525*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INFLOW MEASUREMENTS MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 9: RECTANGULAR PLANFORM BLADES AT AN ADVANCE RATIO OF 0.23, 0.75 CHORD ABOVE THE TIP PATH PLANE (Diskette Supplement)
Susan L. Althoff (Army Aviation Systems Command, Hampton, VA.), Joe W. Elliott (Army Aviation Systems Command, Hampton, VA.), Danny R. Hoad (Army Aviation Systems Command, Hampton, VA.), and Richard H. Sailey (Lockheed Engineering and Sciences Co., Hampton, VA.) May 1990 392 p Diskette supplement: 2 IBM compatible 5.25-inch DSDD diskettes Original contains color illustrations
(RTOP 505-61-51-10)
(NASA-TM-102643; NAS 1.15:102643; AVSCOM-TM-90-B-008-Vol-9; NONP-Suppl-DK-93-159788) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A22; 2 functional color pages

An experimental investigation was conducted in the 14- by 22-Foot Subsonic Tunnel at the NASA Langley Research Center to measure the inflow into a scale model helicopter rotor in forward flight (mu = 0.23). The measurements were made with a two-component Laser Velocimeter (LV) 0.75 chord above the plane formed by the path of the rotor tips (tip-path-plane). A conditional sampling technique was employed to determine the position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 180 separate locations in order to clearly define the inflow character. The mean and standard deviation of the induced ratios and the azimuthally dependent induced inflow ratios are included on 5.25 flexible disk in the pocket on the inside of the rear cover of this report. These data are presented without analysis. Two floppy disks containing Inflow Measurements Volume 9 are included. Author

N93-24527*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INFLOW MEASUREMENTS MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 11: RECTANGULAR PLANFORM BLADES AT AN ADVANCE RATIO OF 0.30, 0.75 CHORD ABOVE THE TIP PATH PLANE (Diskette Supplement)
Susan L. Althoff (Army Aviation Systems Command, Hampton, VA.), Joe W. Elliott (Army Aviation Systems Command, Hampton, VA.), Danny R. Hoad (Army Aviation Systems Command, Hampton, VA.), and Richard H. Sailey (Lockheed Engineering and Sciences Co., Hampton, VA.) May 1990 392 p Prepared in cooperation with Army Aviation Systems Command, Hampton, VA Diskette supplement: 2 IBM compatible 5.25-inch DSDD Original contains color illustrations
(RTOP 505-61-51-10)
(NASA-TM-102645; NAS 1.15:102645; AVSCOM-TM-90-B-010-Vol-11; NONP-Suppl-DK-93-159793) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A22; 2 functional color pages

An experimental investigation was conducted in the 14- by 22-Foot Supersonic Tunnel at the NASA Langley Research Center to measure the inflow into a scale model helicopter rotor in forward flight (mu = 0.30). The measurements were made with a two-component Laser Velocimeter (LV) 0.75 chord above the plane formed by the path of the rotor tips (tip-path-plane). A conditional sampling technique was employed to determine the position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 180 separate locations in order to clearly define the inflow character. The mean and standard deviation of the induced inflow ratios and the azimuthally dependent induced inflow ratio are included on 5.25 flexible disk in the pocket on the inside of the rear cover of this report. These data are presented without analysis. Author

N93-24528*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

INFLOW MEASUREMENTS MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 10: RECTANGULAR PLANFORM BLADES AT AN ADVANCE RATIO OF 0.30, 0.50 CHORD ABOVE THE TIP PATH PLANE (Diskette Supplement)

Susan L. Althoff (Army Aviation Systems Command, Hampton, VA.), Joe W. Elliott (Army Aviation Systems Command, Hampton, VA.), Danny R. Hoad (Army Aviation Systems Command, Hampton, VA.), and Richard H. Sailey (Lockheed Engineering and Sciences Co., Hampton, VA.) May 1990 386 p Diskette supplement: 2 IBM compatible 5.25-inch DSDD diskettes

(RTOP 505-61-51-10)

(NASA-TM-102644; NAS 1.15:102644; AVSCOM-TM-90-B-009-Vol-10; NONP-Suppl-DK-93-159794) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A22

An experimental investigation was conducted in the 14- by 22-Foot Subsonic Tunnel at the NASA Langley Research Center to measure the inflow into a scale model helicopter rotor in forward flight (mu = 0.30). The measurements were made with a two-component Laser Velocimeter (LV) 0.50 chord above the plane formed by the path of the rotor tips (tip-path-plane). A conditional sampling technique was employed to determine the position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 177 separate locations in order to clearly define the inflow character. The mean and standard deviation of the induced inflow ratios and the azimuthally dependent induced inflow ratios are included on 5.25 flexible disk in the pocket on the inside of the rear cover of this report. These data are presented without analysis.

Author

N93-24532*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

INDUCED INFLOW VELOCITY AND BLADE SURFACE PRESSURE MEASUREMENTS FOR A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 1: ADVANCE RATIO OF 0.37, THRUST COEFFICIENT OF 0.0081, AND HOVER TIP SPEED OF 710 FT/SEC (Diskette Supplement)

Joe E. Elliott (Army Aviation Systems Command, Hampton, VA.), Martin A. Peryea (Textron Bell Helicopter, Fort Worth, TX.), Albert G. Brand (Textron Bell Helicopter, Fort Worth, TX.), and Tom L. Wood (Textron Bell Helicopter, Fort Worth, TX.) Apr. 1992 468 p Prepared in cooperation with Army Aviation Systems Command, Hampton, VA Diskette supplement: IBM compatible 3.5-inch DSDD Original contains color illustrations

(RTOP 505-59-36-01)

(NASA-TM-104224; NAS 1.15:104224; AVSCOM-TR-92-B-003-Vol-1; NONP-Suppl-DK-93-159799) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A25; 2 functional color pages

An Advanced Lightweight Rotor (LAR) model was tested in high speed forward flight, mu = 0.37, at the 14- by 22-Foot Subsonic Tunnel at NASA LaRC. The pressure instrumented rotor, provided by Bell Helicopter, was a four-bladed, Mach-scaled, bearingless, soft-in-plane design. Rotor performance data was required from Bell's Powered Force Model (PFM) test stand, and the blade airfoils were obtained using 92 unsteady pressure transducers. A two-component laser velocimeter was used to obtain azimuthally dependent velocities in the inflow region and in the wake of the rotor. Data are presented here without analysis. To facilitate the use of the data sets, they are also provided on a 720 Kbyte 3 1/2-inch floppy disk in Microsoft Corporation MS-DOS format. The disk contains velocity time history data and blade pressure time history data. Author (revised)

N93-24538*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

INFLOW MEASUREMENTS MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 7: RECTANGULAR PLANFORM BLADES AT AN ADVANCE RATIO OF 0.40 (Diskette Supplement)

Danny R. Hoad, Susan L. Althoff, Joe W. Elliott, and Richard H. Sailey (Planning Research Corp., Hampton, VA.) Apr. 1989 388 p Diskette supplement: 2 IBM compatible 5.25-inch DSDD Original contains color illustrations

(RTOP 505-61-51-10)

(NASA-TM-101599; NAS 1.15:101599; AVSCOM-TM-89-B-002; NONP-Suppl-DK-93-159783) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A22; 2 functional color pages

An experimental investigation was conducted in the 14- by 22-Foot Subsonic Tunnel at the NASA Langley Research Center to measure the inflow into a scale model helicopter rotor in forward flight (mu = 0.40). The measurements were made with a two-component Laser Velocimeter (LV) one chord above the plane formed by the path of the rotor tips (tip-path-plane). A conditional sampling technique was used to determine the position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 178 separate locations in order to clearly define the inflow character. Two floppy disks are included that contain Inflow Measurements Volume 7--Rectangular Blades Advance Ratio = 0.40.

Author

N93-24540*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

INFLOW MEASUREMENTS MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 6: RECTANGULAR PLANFORM BLADES AT AN ADVANCE RATIO OF 0.35 (Diskette Supplement)

Danny R. Hoad, Susan L. Althoff, Joe W. Elliott, and Richard H. Sailey (Planning Research Corp., Hampton, VA.) Apr. 1989 391 p Diskette supplement: 2 IBM compatible 5.25-inch DSDD

(RTOP 505-61-51-10)

(NASA-TM-101598; NAS 1.15:101598; AVSCOM-TM-89-B-001; NONP-Suppl-DK-93-159786) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A22

An experimental investigation was conducted in the 14- by 22-Foot Subsonic Tunnel at the NASA Langley Research Center to measure the inflow into a scale model helicopter rotor in forward flight (mu = 0.35). The measurements were made with a two-component Laser Velocimeter (LV) one chord above the plane formed by the path of the rotor tips (tip-path-plane). A conditional sampling technique was used to determine the position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 179 separate locations in order to clearly define the inflow character. Two floppy disks containing Inflow Measurements Volume 6--Rectangular Blades Advanced Ratio = 0.35 are included.

Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N93-22379# Wichita State Univ., KS. National Inst. for Aviation Research.

THE ROLE OF UNIVERSITY RESEARCH IN AVIATION SAFETY AND COMPETITIVENESS: TESTIMONY TO THE US CONGRESS

William H. Wentz, Jr. Feb. 1991 28 p

(NIAR-92-3) Avail: CASI HC A03/MF A01

Presented here are the written and oral testimony of the Executive Director of the National Institute for Aviation Research as it was given before the U.S. House of Representatives Committee on Science, Space, and Technology, Subcommittee on Technology and Competitiveness. Reasons for, and returns on, investment in university-based aviation research are discussed. Some specific activities at Wichita State University that were funded by the Federal Aviation Administration (FAA) include research on crashworthiness, stall-spin safety, electro-impulse-de-icing, the reliability of computer software used in aircraft, structural integrity, aging aircraft, human factors, advanced cockpits, propulsion and fuel systems, atmospheric hazards, flight safety, and other mostly safety-related aviation subjects. Wichita State University has conducted a number of workshops and seminars with the FAA, established a cooperative educational program with the FAA Technical Center, and participated in their Summer Faculty Research program. Barriers to innovation and competitiveness, and examples of

successful research, development, and use of new information and technology are also given, as well as suggestions for improving aviation safety and competitiveness. CASI

N93-22660# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Hauptabt. Verkehrsforschung.
OPTIONS OF AIR TRAFFIC DISTRIBUTION IN THE BERLIN REGION (GERMANY) [MOEGLICHKEITEN EINER AUFTEILUNG DES LUFTVERKEHRS AUF DIE FLUGHAEFEN DER REGION BERLIN]
Dieter Wilken, Stefan Beyhoff, and Volker Warlitzer Oct. 1991 142 p In GERMAN
(Contract BMV-FE-L-7/90-50096/90)
(DLR-FB-91-37; ETN-93-91926) Avail: CASI HC A07/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Policy options for distributing air traffic between Berlin airports are studied. Such traffic distribution might be necessary as sufficient capacity will not be available in the foreseeable future to handle the growing air transport demand by a single Berlin airport. The study proceeds from a set of basic assumptions including the objectives in transport and environmental politics of the relevant political bodies, the air transport forecast for Berlin, and the development of airport capacities. Seven policy options are discussed and analyzed with a view to their application in the case of Berlin. The final policy advice calls for a market segmentation ruling with a continued application of IATA scheduling prodedures. ESA

N93-23004# Deutsche Lufthansa A.G., Cologne (Germany).
[ACTIVITIES REPORT OF LUFTHANSA GERMAN AIRLINES] Annual Report, 1991
Rolf-Dieter Grass, ed. 1992 51 p
(ETN-93-93465) Avail: CASI HC A04/MF A01

The Lufthansa German airlines annual report, which presents evidence of the negative effects of the world recession on the airline industry during 1991, is presented. It opens with a letter to the share holders and then reports to the executive board reviewing the international markets explaining the worldwide slowdown, increased turnover, how capacity exceeded demand, and how fees grew faster than costs. Passenger business, cargo business, financing, personnel, subsiduaries, the fleet, and services are reviewed. ESA

N93-23086# National Transportation Safety Board, Washington, DC.
AIRCRAFT ACCIDENT REPORT: AIR TRANSPORT INTERNATIONAL, INC., FLIGHT 805, DOUGLAS DC-8-63, N794AL. LOSS OF CONTROL AND CRASH, SWANTON, OHIO, 15 FEBRUARY 1992
19 Nov. 1992 122 p
(PB92-910406; NTSB/AAR-92/05) Avail: CASI HC A06/MF A02

This report explains the loss of control and crash of Air Transport International, Inc., flight 805, a Douglas DC-8-63, near Toledo Express Airport, Ohio, after executing a second missed approach to runway 7, on 15 Feb. 1992. The safety issues discussed in the report include unusual attitude recovery training for flightcrews, crew fatigue, and cockpit resource management. Author (revised)

N93-23093 Virginia Polytechnic Inst. and State Univ., Blacksburg.
THE GENERATION OF CARBON MONOXIDE IN COMPARTMENT FIRES Ph.D. Thesis
Daniel T. Gottuk 1992 261 p
Avail: Univ. Microfilms Order No. DA9301010

For the purpose of fire analysis and fire safety engineering, the development of empirical correlations for major species yields in compartment fires has become an important priority due to the inability to calculate these quantities from first principles. Studies of simplified upper layer environments have shown that major species production rates can be correlated with the equivalence ratio in what is known as the Global Equivalence Ratio concept (GER). Due to the simplification in these past experiments, it was not known if the GER concept was valid for compartment fires. Therefore, there was a need to determine if correlations existed between major species yields and the equivalence ratio for actual compartment fires. Since the flow of toxic gases from a room poses a hazard to building occupants, it was also important to determine if correlations for CO yield outside of a compartment on fire exist, particularly when external burning occurs. A 2.2 cu m test compartment was used to investigate the burning of four fuels (hexane, PMMA, spruce and flexible polyurethane foam) in compartment fires. The test compartment was specially designed with a two-ventilation path system which allowed the direct measurement of the plume equivalence ratio (the ratio of the fuel volatilization rate to the air entrainment rate normalized by the stoichiometric fuel-to-air ratio). Empirical correlations between the upper layer yield of major species and the plume equivalence ratio were shown to exist. The results reveal the production of CO is primarily dependent on the compartment flow dynamics (i.e., the equivalence ratio) and upper layer temperature. A chemical kinetics study indicated that increased compartment temperature affects upper layer species yields in two ways: (1) the generation of species in the plume is changed and (2) oxidation of post-flame gases in the layer is affected. The correlations developed in the compartment fires were qualitatively similar to those developed by Beyler for simplified upper layer environments. However, quantitative differences existed and are explained by the temperature effect. The species yields downstream of hexane compartment fires were investigated and compared to upper layer yields. Results showed that downstream CO yields can be correlated to the plume equivalence ratio when taking into account the occurrence of external burning. When sustained external burning occurred for equivalence ratios greater than 1.7, downstream CO yields were reduced to 10 to 25 percent of the upper layer value. Results are very encouraging in indicating that an ignition criterion based on lean flammability limits is useful in predicting the flammability of upper layer gases in compartment fires. An ignition index value of 1.3 indicated the occurrence of sustained external burning and, thus, a reduction of CO, for the hexane fires studied. Dissert. Abstr.

N93-23187# National Transportation Safety Board, Washington, DC.
SAFETY STUDY: ALCOHOL AND OTHER DRUG INVOLVEMENT IN FATAL GENERAL AVIATION ACCIDENTS, 1983 THROUGH 1988
14 Oct. 1992 169 p
(PB92-917008; NTSB/SS-92/03) Avail: CASI HC A08/MF A02

The Safety Board conducted this study to examine alcohol and other drug involvement in fatal general aviation accidents that occurred from 1983 through 1988 and to compare the level of alcohol-involved accidents with the level documented in its 1984 statistical review of alcohol-involved aviation accidents that occurred from 1975 through 1981. For general aviation accidents that were fatal to the pilot-in-command, comparisons are made for two accident groups in terms of accident characteristics, flight conditions, pilot-in-command characteristics, and causes and factors. The alcohol-involved group consists of accidents in which alcohol was cited by the Safety Board as a cause or factor; the second group consists of accidents in which alcohol or other drugs were not cited as a cause or factor. Although the study briefly reviews accidents that were fatal to the pilot-in-command and in which drugs other than alcohol were cited as a cause or factor, the data are too limited for a comparative analysis to the alcohol-involved accidents or to accidents in which alcohol or other drugs were not cited. Derived from text

N93-23191# National Transportation Safety Board, Washington, DC.
AIRCRAFT ACCIDENT REPORT: UNITED AIRLINES FLIGHT 585, BOEING 737-291, N999UA, UNCONTROLLED COLLISION WITH TERRAIN FOR UNDETERMINED REASONS, 4 MILES SOUTH OF COLORADO SPRINGS MUNICIPAL AIRPORT, COLORADO SPRINGS, COLORADO, 3 MARCH 1991
8 Dec. 1992 168 p
(PB92-910407; NTSB/AAR-92/06) Avail: CASI HC A08/MF A02

This report documents the inexplicable loss of United Airlines flight 585, a Boeing 737-291, after the airplane had completed its turn onto the final approach course to runway 35 at Colorado Springs Municipal Airport, Colorado Springs, Colorado, on 3 Mar. 1991. The safety issues discussed in the report are the potential meteorological hazards to airplanes in the area of Colorado Springs, potential airplane or systems anomalies that could have precipitated a loss of control, and the design of the main rudder power control unit servo valve that could present significant flight control difficulties under certain circumstances. Recommendations concerning these issues were addressed to the Federal Aviation Administration. Derived from text

N93-23222# National Inst. of Standards and Technology, Gaithersburg, MD.
MODELING THE HEAT RELEASE RATE OF AIRCRAFT CABIN PANELS Final Report
W. J. Parker and R. Filipczak (Federal Aviation Administration, Atlantic City, NJ.) Feb. 1993 52 p
(Contract DTFA03-87-A-0005)
(DOT/FAA/CT-92/3) Avail: CASI HC A04/MF A01

A computer model was developed to calculate the heat release rate of aircraft cabin composite panels based on the panel's thermophysical, chemical, and geometric properties. The model calculates the temperature through the panel as a function of time and uses this along with measured kinetic constants to deduce mass loss rate which is multiplied by the heat of combustion of the volatiles. The calculated results are in general agreement with the measured heat release obtained from the Ohio State University (OSU) calorimeter. Author

N93-23325# Oak Ridge National Lab., TN.
THE ANNUAL PROBABILITY OF AN AIRCRAFT CRASH ON THE US DEPARTMENT OF ENERGY RESERVATION IN OAK RIDGE, TENNESSEE
R. S. Seigler and L. J. Luttrell Nov. 1992 136 p
(Contract DE-AC05-84OR-21400)
(DE93-005171; ORNL/ENG/TM-36) Avail: CASI HC A07/MF A02

Aircraft hazards were evaluated to determine the total annual probability of an aircraft crash occurring at any structure located on the U.S. Department of Energy (DOE) reservation in Oak Ridge, Tennessee. This report documents the use of an accepted methodology for calculating the probability of an aircraft crash as applied to the three Oak Ridge plant sites including the adjoining facilities. Based on the data contained herein, the evaluation concluded that the probability of an aircraft crash occurrence at a single facility is generally considered 'not credible' as defined in DOE/OR-901. Additionally, reevaluation of probabilities would be necessary if significant changes were made to local air traffic. The probability of an aircraft crash could increase as a result of the opening of any new airport or heliport in the vicinity; a greater volume of air traffic from McGhee Tyson airport in Knoxville, should the airport status change from feeder airport to hub airport; the rerouting of commercial and/or military flights at the McGhee Tyson airport; and finally, a change in direction or the addition of a federal airway. At one time, DOE planned to establish a zone of prohibited airspace over the Y-12 plant; if the plans are enacted in the future, the probability of an aircraft crash at the Y-12 plant could decrease. Pilots since have been voluntarily requested not to fly below 3000 feet over the Y-12 plant. Also, the Federal Aviation Administration plans to reroute air traffic in the spring of 1993 on federal airway V16. However, the section of V16 which traverses the three plant sites and five adjoining facilities will not be altered. If this plan is implemented, the air traffic over the Oak Ridge facilities would not be affected significantly, and the probability of an aircraft crash as determined herein would be unchanged. DOE

N93-24200 Sundstrand Data Control, Inc., Redmond, WA.
GROUND PROXIMITY WARNING SYSTEM FOR USE WITH AIRCRAFT HAVING DEGRADED PERFORMANCE Patent
Charles D. Bateman, inventor (to Sundstrand Data Control, Inc.), John H. Glover, inventor (to Sundstrand Data Control, Inc.), and Hans R. Muller, inventor (to Sundstrand Data Control, Inc.) 11 Feb. 1992 24 p Filed 6 Apr. 1988
(CA-Patent-1-295-716; Int-Patent-Class-G01S-13/94; CTN-93-60640)
Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC

A ground proximity warning system for aircraft is provided which has enhanced warning capability when aircraft performance is degraded due to such factors as wind shear, improper landing configuration, insufficient engine thrust, instrument errors, and degraded lift. According to the invention, the warning envelope of Modes 1 and 3 are extended to within 5 ft. of the ground. Radio altitude rate and barometric altitude rate signals are combined to provide a computed altitude rate signal that is accurate near the ground for use as an input to Modes 1 and 3. The system provides flight path deviation warning utilizing a measure of flight path and aircraft altitude. A means for generating a warning when the aircraft pitch is below a predetermined value after rotation is also included, as well as an output indicating that additional aircraft performance is available. Angle of attack is compared to stall angle of attack to generate an indication that angle of attack should be increased. A pilot indication to apply additional thrust can also be provided. CISTI

N93-24592 Safety (Aircraft and Vehicles) Equipment Ltd. (England).
AIRCRAFT FIRE PROTECTION SYSTEM Patent
James Steel, inventor (to Safety Equipment Ltd.) 10 Mar. 1992 20 p Filed 17 Nov. 1987
(CA-Patent-1-296-970; Int-Patent-Class-A62C-35/58; CTN-93-60668)
Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC

A fire protection system is provided for an aircraft of the type having an onboard water supply system. The system comprises a plurality of spray nozzles dispersed throughout the passenger cabin, a plurality of distribution conduits interconnecting those nozzles, means for selectively connecting those conduits to the aircraft onboard water supply system, and means for optionally connecting those conduits to a source of pressurized water external to the aircraft. The external source connection means is positioned outside the aircraft so as to be accessible to fire fighting personnel outside the aircraft regardless of the aircraft's orientation. Preferably, the distribution conduits are configured to supply each of the plurality of spray nozzles along at least two alternate flow paths so that a redundancy is achieved. It is also preferred that the fire protection system includes means for limiting the flow of water in the distribution conduits in the event of a rupture of one of the conduits upstream of one or more of the plurality of spray nozzles. Author (CISTI)

N93-22562*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
AN INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 1991-1992
Robert W. Simpson *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 3-7
(For primary document see N93-22561 08-01)
Avail: CASI HC A01/MF A02

N93-22564*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
HAZARD EVALUATION AND OPERATIONAL COCKPIT DISPLAY OF GROUND-MEASURED WINDSHEAR DATA
Craig Wanke and R. John Hansman, Jr. *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 21-27 Presented at the AIAA 28th Aerospace Sciences Meeting, Reno, NV, 8-11 Jan. 1990 Previously announced in IAA as A90-19919 and A92-41216 (For primary document see N93-22561 08-01)
(Grants NAG1-690; NGL-22-009-640)
(AIAA Paper 90-0566) Avail: CASI HC A02/MF A02

N93-22565*# Massachusetts Inst. of Tech., Cambridge.
HEAT TRANSFER ON ACCRETING ICE SURFACES
Keiko Yamaguchi and R. John Hansman, Jr. *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 29-34 Presented at the AIAA 28th Aerospace Sciences Meeting, Reno, NV, 8-11 Jan. 1990 Previously announced in IAA as A90-22181 and A92-24415 Sponsored in part by NSF (For primary document see N93-22561 08-01)
(Grants NAG3-666; NGL-22-009-640)
(AIAA Paper 90-0200) Avail: CASI HC A02/MF A02

N93-22566*# Massachusetts Inst. of Tech., Cambridge. Aeronautical Systems Lab.
HAZARD ALERTING AND SITUATIONAL AWARENESS IN ADVANCED AIR TRANSPORT COCKPITS
R. John Hansman, Craig Wanke, James Kuchar, Mark Mykityshyn, Edward Hahn, and Alan Midkiff *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 35-45 Previously announced in IAA as A93-14377 (For primary document see N93-22561 08-01)

(Contract NAG2-12; NAG2-716; NAG1-690; NGL-22-009-640; DTRS-57-88-C-00078; NSF MSS-85-52702)
Avail: CASI HC A03/MF A02

N93-22570*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT PRINCETON UNIVERSITY, 1991-1992
Robert F. Stengel *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 91-100 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

N93-22574*# Princeton Univ., NJ.
OPTIMAL RECOVERY FROM MICROBURST WIND SHEAR
Sandeep S. Mulgund *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 129-140 (For primary document see N93-22561 08-01)
Avail: CASI HC A03/MF A02

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N93-22390# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Cockpitsysteme und Ergonomie.
TERRAIN REFERENCED INFORMATION AND GUIDANCE SYSTEMS (TRIGS)
Dieter Hoffmann and Alexander Rumpf Sep. 1991 10 p In GERMAN Presented at DGLR e.V. Forschungsintitut fuer Anthropotechnik der FGAN e.V. 34th Fachausschusssitzung, Munich, Germany, 24-25 Sep. 1991
(MBB-FE-315-S-PUB-0494; ETN-93-93436) Avail: CASI HC A02/MF A01

The Cooperative Air Traffic Management Concept (CATMAC) is considered, in the framework of the German organization for flight safety. The improvement of the coordination between onboard/ground and aircraft/flight safety is outlined. The technical prerequisites are given. Terrain Referenced Information and Guidance Systems (TRIGS) is shown to contribute as an aircraft oriented landing area guiding system to the required increase of the system capacity. General aspects are considered, such as the reduction of workload in the cockpit, the safety increase in air and on the ground, the reduction of delays, and collision avoidance. ESA

N93-22398# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SOLUTION TO A MULTICRITERIA AIRCRAFT ROUTING PROBLEM UTILIZING PARALLEL SEARCH TECHNIQUES M.S. Thesis
James J. Grimm, II Dec. 1992 248 p
(AD-A259293; AFIT/GCE/ENG/92D-04) Avail: CASI HC A11/MF A03

Pilots select routes based on factors such as threats, fuel, time on target, distance, and refueling points. This is a time consuming task. This thesis presents the software engineering synthesis of a software tool, based on a parallelized A* search algorithm, to select routes. For simplicity only threats and distance are used. A centralized open list is used with one processor managing the list while the other processors perform the node expansions. This decomposition result in a dynamically load balanced system. A number of parameters are changed to study their impact on the execution time. The use of a branch and bound technique and its impact on the execution time is studied. Other parameters examined are the size of the supercomputer and granularity of the algorithm. It is important to match the software granularity to the architecture to ensure maximum utilization of the supercomputer and minimize execution time. Tests were run on both an iPSC/2 and iPSC/860 to determine the effects of the architecture upon the execution time. In conjunction with execution time, the efficient usage of the parallel computer was also examined. GRA

N93-22780# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.
INTEGRATED AND MULTI-FUNCTION NAVIGATION [LES SYSTEMES DE NAVIGATION INTEGRES MULTIFUNCTIONS]
Nov. 1992 169 p Meeting held in Ottawa, Ontario, 14-15 May 1992
(AGARD-CP-525; ISBN-92-835-0693-6) Copyright Avail: CASI HC A08/MF A02

This volume contains the 14 unclassified papers, presented at the Guidance and Control Panel Specialists' Meeting held in Ottawa, Canada from 14th-15th May 1992. The papers were presented covering the following headings: (1) mission applications; (2) sensors for integrated navigation and multi-function reference systems; and (3) design of integrated and multifunctional navigation systems. For individual titles, see N93-22781 through N93-22794.

N93-22781# National Defence Headquarters, Ottawa (Ontario). Directorate Research and Development Communications and Space.
MISSION REQUIREMENTS AND APPLICATIONS OF INTEGRATED AND MULTI-FUNCTION NAVIGATION SYSTEMS
David Feseng Liang *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 20 p (For primary document see N93-22780 08-04)
Copyright Avail: CASI HC A03/MF A02

Advanced guidance, control and navigation systems are becoming more functional and integrated. This paper describes Canadian experience in the development and applications of Integrated and Multi-function Navigation Systems. The emphasis is on the development of two distinct mission-specific inertially based integrated navigation systems. In particular, in a high risk development project such as the Synthetic Aperture Radar Motion Compensation System, the special attention given to the detailed assessment of key error sources and a well-planned sequence of simulation, development and flight test evaluation are essential to the success of the project. For Multifunctional inertially-based systems, the hardware design emphasis should be on IMU architectures that minimize both the acquisition and life-cycle cost, while the software design emphasis should be on practical and efficient FDIR schemes. Some comments were also offered on the trends of GPS related future applications. Author

N93-22782# Wright Lab., Wright-Patterson AFB, OH. Avionics Directorate.
OPPORTUNITIES AND CHALLENGES IN AVIONICS INTEGRATION, INS/GPS: A CASE STUDY
Zdzislaw H. Lewantowicz (Air Force Inst. of Tech., Wright-Patterson AFB, OH.) and Danny W. Keen (Aeronautical Systems Div., Wright-Patterson AFB, OH.) *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 8 p (For primary document see N93-22780 08-04)
Copyright Avail: CASI HC A02/MF A02

Several recent technological developments (including the advent of GPS and the virtual explosion of computational capability) offer unprecedented opportunities for radically different approaches to providing weapon system capabilities. In the past high-rate raw sensor data would have to be sampled, or significantly pre-processed in a separate (dedicated) computer, before such data could be used within the constraints of a real time weapon system application. During such sampling/pre-processing much of the information content could be lost. The current computational capability explosion now permits highly complex algorithmic solutions to be executed within real time. Such computational capabilities within an integrated avionics architecture offer opportunities for maximum rate fusion of all raw signals directly from the sensors, where they are generated, with little or no information loss. As an example, when unfiltered GPS information is directly/optimally combined at maximum rate with inertial data, not only is the navigation accuracy increased, but effective susceptibility to GPS signal dropout/jamming is significantly reduced. Additionally, the resultant highly precise GPS/INS position, velocity, attitude, and time information can serve as a common integrating agent for combining the information from a variety of other mission sensors and communication devices. A system engineering process is required to systematically explore and exploit the yet untapped opportunities presented by these technological advancements. The essential ingredients of this process are a system level perspective, sound modeling and simulation, and the application of analytic tools. Author

N93-22783# Litton Guidance and Control Systems, Woodland Hills, CA.
AN OVERVIEW OF OPTICAL GYROSCOPES FOR NAVIGATION c35

J. G. Mark and D. A. Tazartes *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 9 p (For primary document see N93-22780 08-04)

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In the 1980's, Ring Laser Gyroscopes (RLG) displaced the mechanical (spinning wheel) gyroscope as the angular sensor of choice for navigation. While the RLG remains the standard navigation grade instrument, several other optical gyroscopes have recently appeared. The multi oscillator (or four-mode gyro) represents a new generation in laser gyroscopes. Systems based on this technology are now being delivered for use on commercial and military aircraft. Another optical sensor, the fiber optic gyroscope (FOG) has been incorporated in inertial measurement units (IMU) and proved itself capable of AHRS (attitude and heading reference system) accuracy. This gyroscope should find many applications in aided navigation systems. Integrated FOG/GPS systems appear attractive as low cost navigators. This paper addresses technology involved in these optical gyroscopes and discusses their advantages and disadvantages in relation to present and future applications. Author

N93-22784# Delco Electronics, Goleta, CA.

HEMISPHERICAL RESONATOR GYRO: PRINCIPLE, DESIGN, AND PERFORMANCE **c35**

W. W. Stripling and John R. Baskett *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 6 p (For primary document see N93-22780 08-04)

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The Hemispherical Resonator Gyro (HRG) is a new-technology rotation-sensing instrument based on the precession of a standing wave around a vibrating hemispherical form. This paper presents the principle of the HRG and describes the design and performance of some actual instruments. Author

N93-22785# LITEF, Freiburg (Germany).

FIBER OPTIC GYROS AND SYSTEMS **c35**

H.-J. Bueschelberger and E. Handrich *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 13 p (For primary document see N93-22780 08-04)

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Fiber Optic Gyroscopes have emerged from the engineering laboratories and come into production. Conventional gyros will be replaced by the fiber optical gyros in most applications in the near future. LITEF has developed a family of gyros and systems based on these gyros. The introduction of the new technology brings many advantages with respect to function, performance, size and weight. Author

N93-22786# Sextant Avionique, Valence (France).

SILICON ACCELEROMETER FOR AHRS AND HYBRID NAVIGATION SYSTEMS [ACCELEROMETRE SILICIUM POUR AHRS ET SYSTEMES HYBRIDES DE NAVIGATION] **c35**

J. Leclerc, A. Defosse, and O. Lefort *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 5 p In FRENCH (For primary document see N93-22780 08-04)

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The SEXTANT Avionic company possesses a large spectrum of accelerometers for the different applications of Navigation. Since 1980, a constant concern about their adequacy to meet the need has led SEXTANT Avionic to develop micro-machined captors and accelerometers in particular. Many types of materials have been used and we expose the reasons for the choice of silicon in accelerometers destined for AHRS. The architecture of the accelerometer, the technologies used, and the functional modes are described. Then the actual performances of the different types of silicon accelerometers are explained, as well as their domain of application. In conclusion, perspectives of a longer term are given. Author

N93-22787# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France).

OPTIMIZATION OF THE INTEGRATION OF INERTIA AND GPS [INTEGRATION OPTIMISEE DE L'INERTIE ET DU GPS]

M. Loiec Camberlein, Bernadette Capit, and M. Pascal Debanne *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 9 p In FRENCH (For primary document see N93-22780 08-04)

Copyright Avail: CASI HC A02/MF A02

ULISS NG is an Inertia-GPS unit and an interesting example of INS/GPS synergy and performance/cost trade-off. It belongs to the ULISS family of INS already fitted to a number of different aircraft. Its miniaturized code twelve channel embedded receiver, with its RF and digital modules, totals 0.7, 1, 7 kg and 12 W. Its parallel tracking maximizes navigation continuity, smoothness, accuracy and minimizes reaction time and oscillator size. The tight Inertia-GPS coupling, i.e., tight inertial aiding and tight hybrid navigation Kalman filter, has been designed to favor operational capabilities, performance and solution stability. Four versions of the SAGEM embedded GPS receiver have been developed C/A-SPS, C/A-SA-PPS and P(Y)L1 and P(Y)L1/L2. The P code version is presented in the paper. Flight tests are being conducted in a Mirage 3 at the French Official Flight Test Center of Bretigny starting in May. Author

N93-22788# GEC Ferranti, Edinburgh (Scotland). Navigation Systems Div.

RETROFITTING OF GPS INTO EXISTING NAVIGATION SUITES

D. I. Callender and N. F. Watson *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 18 p (For primary document see N93-22780 08-04)

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As GPS signal availability reaches operationally useful levels, and in particular following experience of its usefulness in the Gulf operations, widespread requirements are beginning to arise for the incorporation of GPS into existing combat aircraft. A considerable amount of study and development work has been carried out by GEC Ferranti to investigate different approaches to integrating GPS into existing navigation systems with the minimum impact on installation, interfacing and operating procedures. This paper describes some different approaches to integrating GPS together with their relative merits and deficiencies. Two practical systems are described in detail and some simulation and trials results are presented together with some aspects of the GPS integration which will form the basis of future development work. Author

N93-22789# Technische Univ., Brunswick (Germany). Inst. of Flight Guidance and Control.

INTEGRATED PRECISION NAVIGATION SYSTEM

G. Schaenzer and B. Tiemeyer *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 10 p (For primary document see N93-22780 08-04)

Copyright Avail: CASI HC A02/MF A02

Combined Satellite and Inertial Navigation Systems can achieve extremely high positioning accuracies in the sub meter range even in the dynamic environment of aircraft. This paper presents the concept of the 'Integrated Navigation System' developed at the Institute of Flight Guidance using coupled satellite and inertial sensors. Flight test results are shown, which demonstrate that this system has the potential to achieve the accuracy requirements according to ICAO CAT 3 for high precision approaches even under bad weather conditions. Author

N93-22790*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

FLIGHT EVALUATION OF DIFFERENTIAL GPS AIDED INERTIAL NAVIGATION SYSTEMS

B. David McNally, Russell A. Paielli, Ralph E. Bach, Jr., and David N. Warner, Jr. *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 17 p (For primary document see N93-22780 08-04)

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Algorithms are described for integration of Differential Global Positioning System (DGPS) data with Inertial Navigation System (INS) data to provide an integrated DGPS/INS navigation system. The objective is to establish the benefits that can be achieved through various levels of integration of DGPS with INS for precision navigation. An eight state Kalman filter integration was implemented in real-time on a twin turbo-prop transport aircraft to evaluate system performance during terminal approach and landing operations. A fully integrated DGPS/INS system is also presented which models accelerometer and rate-gyro measurement errors plus position, velocity, and attitude errors. The fully integrated system was implemented off-line using range-domain (seventeen-state) and position domain (fifteen-state) Kalman filters. Both filter integration approaches were evaluated using data collected during the flight test. Flight-test data consisted of measurements from a 5 channel Precision Code GPS receiver, a

strap-down Inertial Navigation Unit (INU), and GPS satellite differential range corrections from a ground reference station. The aircraft was laser tracked to determine its true position. Results indicate that there is no significant improvement in positioning accuracy with the higher levels of DGPS/INS integration. All three systems provided high-frequency (e.g., 20 Hz) estimates of position and velocity. The fully integrated system provided estimates of inertial sensor errors which may be used to improve INS navigation accuracy should GPS become unavailable, and improved estimates of acceleration, attitude, and body rates which can be used for guidance and control. Precision Code DGPS/INS positioning accuracy (root-mean-square) was 1.0 m cross-track and 3.0 m vertical. (This AGARDograph was sponsored by the Guidance and Control Panel.) Author

N93-22791# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Dept. of Aerospace Technology.

VISUAL AUTONOMOUS AUTOMATIC LANDING OF AIRPLANES

E. D. Dickmanns and F.-R. Schell *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 9 p (For primary document see N93-22780 08-04)

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A visual sensor data processing method has been developed and validated which allows to achieve on board autonomous landing approaches in the visual flight regime with computing technology available today; sensors are a video-camera, inertial gyros and an air velocity meter. The key feature of the method is the reconstruction and servo-maintained adjustment by prediction error feedback of an internal spatio-temporal model about the process to be controlled (4D approach). This encompasses both the ego motion state of the aircraft carrying the sensors and the relevant geometric properties of the runway and its spatial environment. The efficiency of the approach is proved both in a hardware-in-the-loop simulation and in real test-flights with a twinturbo-prop aircraft Do 128 of Dornier. For accuracy evaluation of the data gathered, the results of differential GPS and radio metric altitude measurements have been recorded simultaneously. Author

N93-22792# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. of Flight Guidance.

SCENE CORRELATION FOR INS AIDING IN FLIGHT-TEST SYSTEMS: RUNWAY-REFERENCED FLIGHT-TESTS WITH ON-BOARD SENSORS ONLY

B. Stieler and H.-U. Doehler *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 15 p (For primary document see N93-22780 08-04)

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Inertial and image-derived measurements for runway referenced flight path computations are investigated. They open the way for flight-tests without ground-based sensors and with a minimum of a priori knowledge or none at all about the runway position and direction in absolute coordinates. They are ideally suited for inspecting landing aids at congested civil airports, for instance. The investigations concentrate on the problems of the baroinertial and inertial altitude measurements, on the achievable accuracies of image-derived measurements and their integration with inertial measurements. It is shown that glide path and flight track accuracies in the order of 0.01 deg (1 sigma) should be achievable. Author

N93-22793# Defence Research Establishment, Ottawa (Ontario). Communication and Navigation Section.

AN HIERARCHIC ALLIANCE OF FILTERS FOR FAULT TOLERANT NAVIGATION USING TWO INERTIAL SYSTEMS WITH AIDING SENSORS

J. Chris McMillan, Jeff S. Bird, and Dale A. G. Arden (Computers and Concepts Associates, Ontario.) *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 11 p (For primary document see N93-22780 08-04)

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A Dual Inertial Integrated Navigation System (DIINS) is being developed for the Canadian Navy to improve the navigational accuracy and reliability on ships which have two inertial navigators plus other aiding navigation systems and sensors such as GPS, Loran-C, Omega, Doppler Speed Log(s) and so on. The sensor integration architecture being proposed to optimally combine all navigation sensors on such a vessel is an 'hierarchic alliance' of Kalman filters, which is designed to allow sensitive error compensation as well as complete fault detection isolation and reconfiguration (FDIR). This architecture is ideally suited to central processing, can take advantage of parallel processing, and provides significant advantages over both the conventional unifilter approach and the 'federated' (or cascaded) filter approach. This hierarchic alliance consists of a specific set of optimal filters running in parallel, with each filter processing measurements from a different subset of the navigation sensors. These filters can be partially ordered so that primary and secondary filters can be defined. The primary filter(s) provide the optimal navigation solution, while the secondary filters provide uncorrupted backup in the event of a sensor fault. The primary motivating factor for this architecture is to provide optimal integration under all conditions, and in particular after the occurrence of subtle sensor faults which could not be immediately detected and which could therefore corrupt the primary filter(s). This alliance of filters can provide an uncorrupted optimal solution, since it can be configured so that there will always be a secondary filter which, at the time of failure, was running independently of the faulty sensor. This removes the usual need to 'back out' of a failure which was not immediately detected and thus substantially simplifies reconfiguration in response to such a failure. Another motivating factor for this architecture is that the partial independence of the parallel filters also facilitates the detection and isolation of sensor faults. This can be accomplished by multiple levels of statistical hypothesis testing on a set of parallel Kalman filters. Fault detection techniques used include the usual sensor data reasonableness and filter residual tests as well as a chi-square hypothesis testing technique applied to the state vectors, and inter-filter voting applied to the residuals test results. While this approach is computationally intensive, modern software techniques, and soon to be available processing power, are expected to make the real time implementation of this hierarchic alliance of filters quite practical. The system envisioned in this paper is being designed and built at the Defence Research Establishment Ottawa for the Canadian Navy and is expected to see initial real-time sea trials in 1993. Author

N93-22794*# Ohio Univ., Athens. Avionics Engineering Center.

TOWARD ACHIEVING GLOBAL SOLE MEANS RADIONAVIGATION SYSTEMS

F. vanGraas *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 10 p (For primary document see N93-22780 08-04)

(Contract NGR-009-017; DTRS-57-87-C-00006)

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This paper briefly reviews tentative requirements for global, earth-referenced sole means of navigation systems with emphasis on integrity and availability. These requirements can be allocated to integrated navigation system architectures based on for instance GPS, GLONASS, VOR/DME, TACAN, Omega, Chayka, and Loran-C. Fault detection and isolation techniques (FDI) for integrated radio navigation systems are presented. The FDI algorithm provides a protection radius with a specified confidence level as a function of measurement geometry and algorithm requirements. This is followed by a case study of integrated GPS/Loran-C. Author

N93-22801# Federal Aviation Administration, Atlantic City, NJ. Technical Center.

AIR TRAFFIC OPERATIONAL EVALUATION PLAN OF THE AUTOMATED SURFACE OBSERVING SYSTEM (ASOS) DISPLAYS

William Brenner, Chris Malitsky, Alanna Randazzo, and Bruce E. Ware Mar. 1993 36 p

(DOT/FAA/CT-TN92/36) Avail: CASI HC A03/MF A01

The Automated Surface Observing System (ASOS) is a weather collection and display system that will be installed in airport traffic control towers (ATCT). The system is being procured, installed, operated, and maintained by the National Weather Service (NWS) for the Federal Aviation Administration (FAA). The FAA's evaluation of the limited production ASOS system, which is being produced by SMI Corporation, is outlined. The FAA will conduct the evaluation of the limited production ASOS at seven air traffic field sites. Four of the named sites will be commissioned and the controller will be expected to use only that weather information generated by the ASOS and have the capability of inputting tower observed visibility when it falls below 4 miles. The remaining three sites will be noncommissioned sites where the controllers will undergo training and then evaluate the ASOS as they familiarize themselves with the system. Two of the three sites are also Limited Aviation Weather Reporting Station (LAWRS) which will permit the controller to augment the weather. Data will be collected via questionnaires completed by the air traffic control

specialists (ATCS) at the seven sites and analyzed by FAA Technical Center personnel. The results of the evaluation will be used for consideration in making changes to the ASOS system prior to full production.
Author (revised)

N93-23063# Federal Aviation Administration, Atlantic City, NJ.
STRUCTURE AND UTILITY OF BLIND SPEED INTERVALS ASSOCIATED WITH DOPPLER MEASUREMENTS OF RANGE RATE
Robert G. Mulholland Feb. 1993 62 p
(DOT/FAA/CT-TN92/27) Avail: CASI HC A04/MF A01

In the case of a coherent pulsed radar system, the time rate of change of the slant range of an aircraft may be determined to within an integer multiple of a known speed by measuring the pulse-to-pulse phase shift in the reflection of a transmitted wave train of electromagnetic energy. The integer multiplier is not necessarily a known, and lack of knowledge of the multiplier gives rise to an ambiguity. The ambiguity may be removed by appropriate processing of the pulse-to-pulse phase shift in the reflection of each of two wave trains that differ in one or both of the dimensions of interpulse period and carrier frequency. The processing is tantamount to a two-phase estimation procedure that is based on some properties of a collection of intervals of real numbers generated by two known speeds that serve as the moduli of distinct congruence relations. There is a connection between this procedure and the use of the Chinese remainder theorem in a multiple channel search system as a means for determining true slant range from several ambiguous range cell numbers. Author

N93-23419*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SIMULATION EVALUATION OF A LOW-ALTITUDE HELICOPTER FLIGHT GUIDANCE SYSTEM ADAPTED FOR A HELMET-MOUNTED DISPLAY
Harry N. Swenson, Richard E. Zelenka, Gordon H. Hardy, and Munro G. Dearing Feb. 1992 15 p
(RTOP 505-64-36)
(NASA-TM-103883; A-91219; NAS 1.15:103883) Avail: CASI HC A03/MF A01

A computer aiding concept for low-altitude helicopter flight was developed and evaluated in a real-time piloted simulation. The concept included an optimal control trajectory-generation algorithm based upon dynamic programming and a helmet-mounted display (HMD) presentation of a pathway-in-the-sky, a phantom aircraft, and flight-path vector/predictor guidance symbology. The trajectory-generation algorithm uses knowledge of the global mission requirements, a digital terrain map, aircraft performance capabilities, and advanced navigation information to determine a trajectory between mission way points that seeks valleys to minimize threat exposure. The pilot evaluation was conducted at NASA ARC moving base Vertical Motion Simulator (VMS) by pilots representing NASA, the U.S. Army, the Air Force, and the helicopter industry. The pilots manually tracked the trajectory generated by the algorithm utilizing the HMD symbology. The pilots were able to satisfactorily perform the tracking tasks while maintaining a high degree of awareness of the outside world. Author (revised)

N93-23587 Texas Univ., Austin.
PRECISE GPS-BASED TRACKING OF REMOTE SENSING SATELLITES Ph.D. Thesis
George Edward Powell, Jr. 1992 254 p
Avail: Univ. Microfilms Order No. DA9239337

The Global Positioning System (GPS), when fully deployed, will make possible an entirely new, geometric method of precise orbit determination. The geometric approach requires continuous collection of pseudorange measurements from at least four GPS satellites, and simultaneous acquisition of carrier phase data for pseudorange smoothing. While the GPS satellite orbits are determined utilizing the classical technique, within the geometric framework, no force model representation for the user satellite is required. However, in spite of the dynamic modeling related benefits of geometric tracking, this non-dynamic technique has its own measurement liabilities. The geometrically determined orbit is extremely sensitive to the observing geometry, clock errors, accuracy of the GPS ephemerides, and other measurement error sources such as signal multipath. Therefore, a hybrid, reduced-dynamic, method has been formulated which utilizes both measurement and dynamic information for the low satellite and weights the dynamic information relative to the geometric by compensating for process noise in the user satellite force mode. For sigma(i) approaches 0 and sigma(i) approaches infinity, where sigma(i) is the steady state uncertainty in the process noise for the i-th batch interval, the state of the user satellite with respect to a reference dynamic orbit is estimated purely dynamically or purely kinematically, respectively. The focus of this work is the determination of realistic orbit errors for GPS-based reduced-dynamic tracking of remote sensing satellites including the Earth Observing System (EOS), and the Ocean Topography Experiment (TOPEX). Comprehensive error models were developed for GPS-based tracking of TOPEX and EOS, and the Orbit Analysis SImulation Software (OASIS) was modified to simulate reduced-dynamic tracking of these satellites. The orbits of both the GPS and user satellites were estimated by processing undifferenced pseudorange and carrier phase information. Each transmitter and receiver clock was estimated as a white noise process noise parameter, and constant phase biases were computed for each transmitter-receiver pair per pass. Simulations were combined with consider covariance analysis to determine realistic TOPEX and EOS orbit errors. The reduced-dynamic tracking technique is examined from a dynamic perspective. The benefits of estimating clock parameters rather than eliminating them is discussed, especially as it relates to science support and intercontinental time transfer. Comparisons between dynamic, kinematic, and reduced-dynamic tracking and their associated performance are presented along with recommendations for future research. Dissert. Abstr.

N93-23652# Department of Transportation, Cambridge, MA. National Transportation Systems Center.
AIDS TO NAVIGATION SERVICE FORCE MIX 2000 PROJECT. VOLUME 2: DEVELOPMENT AND APPLICATION OF AN AIDS TO NAVIGATION SERVICE FORCE MIX DECISION SUPPORT SYSTEM. AID ASSIGNMENTS AND VESSEL SUMMARY REPORTS Final Report, Jan. 1991 - Jun. 1992
Kip Brown, Judith Schwenk, and Mark Bucciarelli Jun. 1992 177 p
Sponsored by Coast Guard
(Contract CG269/B2006)
(PB93-142362; DOT-VNTSC-CG-92-2.2; DOT-CG-N-01-92-1.3) Avail: CASI HC A09/MF A02

The Aids to Navigation (ATON) Service Force Mix (SFM) 2000 Project is documented in a project overview and three separately bound volumes. This is volume 2. The project overview describes the purpose, approach, analysis, and results of the ATON SFM 2000 Project conducted by the USCG's Office of Navigation Safety and Waterway Services, Short Range Aids to Navigation Division. Volume 1, Development and Application of an Aids to Navigation Service Force Mix Decision Support System -- Final Report, documents the Volpe Center's analysis and development of the proposed replacement buoy tender fleet. The document describes current ATON operations, the concept, development, and operation of the Decision Support System (DSS); the data utilized by the DSS; validation of the DSS; and the proposed service force mix. Volume 2, Development and Application of an Aids to Navigation Service Force Mix Decision Support System -- Aid Assignments and Vessel Summary Reports, contains the DSS outputs associated with the findings of volume 1. Included are maps of the aid assignments for each vessel in both the current and proposed fleets and the associated one-page DSS summary printouts. Volume 3, Analysis of Multi-Mission Requirements and Development of Planning Factors for the Replacement Buoy Tender Fleet, documents the USCG's analysis and development of baseline multi-mission requirements of the replacement buoy tender fleet. The document describes buoy tender employment categories, historical tender employment data, the determination of underway hours per underway day, and projected impacts on multimission requirements resulting from alternative replacement fleet scenarios. GRA

N93-24105 Civil Aviation Authority, London (England).
TCAS 2: REPORT ON UK OPERATIONAL TRIAL
David A. Howson May 1992 117 p Original contains color illustrations
(CAA-Paper-92011; ISBN-0-86039-5219; ETN-93-93566) Copyright
Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, United Kingdom, HC

The UK (United Kingdom) operational trial of TCAS 2 (Traffic Alert and Collision Avoidance System) is reported. Pretrial activities, data collection, and data analysis of airborne and ground radar recording are described. Events of interest are discussed. In TCAS terms, the quantity of data

collected during the trial is recognized to be comparatively small. Therefore, great care was taken in analyzing the results to try to avoid reading too much into the data. However, some significant and obvious trends are identified. The main features of the RA (Resolution Advisories) and TA (Traffic Advisories) data are described. The implications of TCAS as they may affect aircraft operators, UK ATC (Air Traffic Control) providers, and the Safety Group of the UK CAA (Civil Aviation Authority), are discussed. ESA

N93-24124 Royal Aerospace Establishment, Bedford (England).
OFF-SHORE PLATFORM IDENTIFICATION SIGNS
A. J. Smith London, England Civil Aviation Authority Apr. 1992 17 p
(CAA-Paper-92006; DRA-WP(91)-052; ISBN-0-86039-509-X; ETN-93-93565)
Copyright Avail: Civil Aviation Authority, Graville House, 37 Gratton Road, Cheltenham, United Kingdom, HC

A study to define the operational requirements for rig identification signs and to propose a specification for the physical characteristics of a sign that will meet the operational requirements is presented. Design considerations of conspicuity, legibility, atmospheric attenuation, and other factors are described and discussed. The following are concluded: the pilot needs to see the rig identification aid at a range of 1250 m, by day and by night in visibilities down to 1250 m; the visual aid must be usable from a range of at least 900 m in the conditions given above; the signs currently displayed in rigs do not have sufficient luminance contrast; the contrast of the signs is very variable and dependent on environmental factors, as a result of which the useful range of the signs is also very variable and is often insufficient; and a sign board of the type currently in use will generally have a range less than the meteorological visibility, whereas a lit sign or beacon can have ranges in excess of the meteorological visibility. It is recommended that a new visual aid be specified. There are two options: either provide an identification beacon or develop a sign that has high contrast levels and adequate intensity to be legible at ranges in excess of 1000 m. Both options are technically feasible with current technology. The choice will primarily be a flight operations decision. In either case a prototype unit could be made available for trials during the first half of 1992. ESA

N93-24138# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Abt. Systemtechnik und Navigation.
TESTING OF A GPS RECEIVER GLOBUS AN 2000 OF SEL: A STUDY OF SELECTIVE AVAILABILITY [FLUGERPROBUNG EINES GPS-EMPFAENGERS GLOBUS AN 2000DER FIRMA SEL: UNTERSUCHUNG VON 'SELECTIVE AVAILABILITY']
Hans-Peter Zenz Apr. 1992 40 p In GERMAN
(DLR-Mitt-92-07; ETN-93-93523) Avail: CASI HC A03/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The development of the GPS (Global Positioning System) has been continuing since the early seventies. During the test period from May to Jul. 1991 15 satellites were available for navigation purposes. For flight testing of the GPS, a GPS receiver (GLOBOS AN 2000) was mounted in an aircraft DO 228. The reference trajectories were determined by the Avonics Flight Evaluation System (AFES). The effect of 'selective availability' is shown in several test series. ESA

N93-24222# Department of the Navy, Washington, DC.
RELATIVE MOTION PINWHEEL Patent Application
Gary E. Streiner, inventor (to Navy) and Leslie P. Benda, inventor (to Navy) 5 Oct. 1992 13 p
(AD-D015629; US-Patent-Appl-SN-956327; Navy-Case-73981) Avail: CASI HC A03/MF A01

An apparatus for visualizing relative motion between two moving objects in a two-dimensional plane is provided. A planar base has a first compass rose printed thereon. Rotatably attached to the center of the first compass rose is a means for indicating a present course of a first moving object relative to a true bearing indication on the first compass rose. A second moving object assembly consists of a second compass rose rotatably attached to a means for indicating a present course of the second moving object relative to a true bearing indication on the second compass rose. The true bearing indication on the second compass rose is aligned to be equivalent to the true bearing indication on the first compass rose. Attached at the centers of the first and second compass roses is a means for tethering the second moving object assembly to the first compass rose. The second compass rose is free to rotate about its center and the second moving object assembly is free to revolve in a single-plane around the center of the first compass rose. The tethering means indicates a line of relative bearing from the first moving object to the second moving object. GRA

N93-24310# Coast Guard Academy, New London, CT. Center for Advanced Studies.
ANALYSIS OF DGPS MSK RECEIVERS IN A NON-GAUSIAN NOISE ENVIRONMENT
Benjamin Peterson, Keith Gross, Eric Chamberlin, Gregory Czerwonka, and William Jones Jan. 1993 12 p Presented at the Institute of Navigation National Technical Meeting, Washington, DC, 1993
(PB93-152866; USCGA-03-93) Avail: CASI HC A03/MF A01

A summary of ongoing research analyzing the atmospheric noise environment and various structures of minimum shift keying (MSK), receivers for differential GPS (DGPS) signals is presented. The purpose of the study is to assist in the Coast Guard's planning of the future DGPS broadcasting system in the U.S. The purpose is not necessarily to develop the optimum receiver but to determine how well typical high quality receivers operate in the atmospheric noise environment. The information is intended for use in the development of minimum performance specifications and in establishing parameters for determining coverage limits. Issues considered include how to define signal to noise ratio with noise probability density functions that suggest infinite noise variance, and comparative performance of various receiver structures, techniques for handling impulse noise, and bandwidths. GRA

N93-24489# Department of Transportation, Cambridge, MA. National Transportation Systems Center.
AIDS TO NAVIGATION SERVICE FORCE MIX 2000 PROJECT. VOLUME 3: ANALYSIS OF MULTI-MISSION REQUIREMENTS AND DEVELOPMENT OF PLANNING FACTORS FOR THE REPLACEMENT BUOY TENDER FLEET Final Report, Jul. 1991 - Jun. 1992
Dennis Ihnat Jun. 1992 62 p Sponsored by Coast Guard
(Contract CG269/B2006)
(PB93-142370; DOT-VNTSC-CG-92-2.3; DOT-CG-N-01-92-4.1) Avail: CASI HC A04/MF A01

The Aids to Navigation (ATON) Service Force Mix (SFM) 2000 Project is documented in a Project Overview and three separately bound volumes. Volume 3 is discussed. The Project Overview describes the purpose, approach, analysis, and results of the ATON SFM 2000 Project conducted by the USCG's Office of Navigation Safety and Waterway Services, Short Range Aids to Navigation Division. Volume 1, Development and Application of an Aids to Navigation Service Force Mix Decision Support System - Final Report, documents the Volpe Center's analysis and development of the proposed replacement buoy tender fleet. Current ATON operations, the concept, development, and operation of the Decision Support System (DSS), the data utilized by the DSS, validation of the DSS, and the proposed service force mix are described. Volume 2, Development and Application of an Aids to Navigation Service Force Mix Decision Support System - Aid Assignments and Vessel Summary Reports, contains the DSS outputs associated with the findings of Volume 1. Included are maps of the aid assignments for each vessel in both the current and proposed fleets and the associated one-page DSS summary printouts. Volume 3, Analysis of Multi-Mission Requirements and Development of Planning Factors for the Replacement Buoy Tender Fleet, documents the USCG's analysis and development of baseline multi-mission requirements of the replacement buoy tender fleet. Buoy tender employment categories, historical tender employment data, the determination of underway hours per underway day, and projected impacts on multi-mission requirements resulting from alternative replacement fleet scenarios are described. Author (revised)

N93-22563*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
THE ASLOTS CONCEPT: AN INTERACTIVE, ADAPTIVE DECISION SUPPORT CONCEPT FOR FINAL APPROACH SPACING OF AIRCRAFT (FASA). FAA-NASA JOINT UNIVERSITY PROGRAM
Robert W. Simpson *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 9-20

(For primary document see N93-22561 08-01)
Avail: CASI HC A03/MF A02

N93-22568*# Ohio Univ., Athens.
FAULT DETECTION AND ISOLATION
Greg Bernath *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 67-76 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

N93-22569*# Ohio Univ., Athens.
GPS MULTIPATH ERRORS IN THE PRECISION LANDING ENVIRONMENT
James D. Waid *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 77-88 (For primary document see N93-22561 08-01)
(Grants NAG1-1423; NGR-36-009-017)
Avail: CASI HC A03/MF A02

N93-22571*# Princeton Univ., NJ.
ADVANCED AIR TRAFFIC MANAGEMENT
J. P. Wangermann *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 101-106 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

N93-22572*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
COMPUTER AIDED CONTROL SYSTEM DESIGN (CACSD)
Frank T. Stoner *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 107-113 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

N93-22573*# Princeton Univ., NJ.
SYNTHESIS OF ROBUST CONTROLLERS
Chris Marrison *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 115-127 (For primary document see N93-22561 08-01)
Avail: CASI HC A03/MF A02

N93-23509# Department of Transportation, Washington, DC.
THE ROLE OF GPS IN A FUTURE RADIONAVIGATION MIX: TRENDS IN THE 1992 US FEDERAL RADIONAVIGATION PLAN
Heywood O. Shirer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 9-14 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23513# Royal Geographical Society, London (England). Royal Inst. of Navigation.
A EUROPEAN RADIONAVIGATION PLAN?
D. W. Broughton *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 33-35 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23519# Beukers Technologies, Inc., Vero Beach, FL.
FINANCIAL ALTERNATIVES FOR GLOBAL SATELLITE NAVIGATION
John M. Beukers *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 61-66 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23522# Racal Survey Ltd., London (England).
SKYFIX: A BETTER POSITION THROUGH THE USE OF INMARSAT AND GPS
G. A. H. Mack *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 81-86 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23523# Technische Univ., Brunswick (Germany). Inst. of Flight Guidance and Control.
PRECISE FLIGHT NAVIGATION BY INTEGRATION OF GLOBAL POSITIONING SYSTEM AND INERTIAL MEASUREMENT UNITS
Stefan Vieweg *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 87-92 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23524# Niedersaechsisches Landesverwaltungsamt, Hanover (Germany). Abt. Landesvermessung.
A PERMANENT NEAR-ONLINE HIGH PRECISION POSITIONING SERVICE (HPPS) WITH GPS
Wolfgang Augath *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 93-95 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23528# Technische Univ., Munich (Germany). Inst. fuer Landtechnik.
SATELLITE NAVIGATION IN AGRICULTURE
H. Auernhammer and K. Wild *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 117-120 (For primary document see N93-23507 08-43)
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N93-23529# Centre National d'Etudes Spatiales, Toulouse (France).
TOWARDS GLOBAL SATELLITE NAVIGATION
J. M. Durand *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 121-125 (For primary document see N93-23507 08-43)
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N93-23533# Inmos Ltd., Bristol (England).
AN INTEGRATED CAR NAVIGATION SYSTEM USING A SINGLE PROCESSOR FOR GPS SIGNAL PROCESSING, POSITIONING, MAP DISPLAY, AND REPORTING
Philip G. Mattos *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 141-145 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23534# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (Germany).
NAVSAT: AN APPLICATION OF GPS AND GLONASS FOR THE CIVIL USER COMMUNITY
Martin Haunschild, N. Niklasch, B. Eissfeller (Kayser Threde G.m.b.H., Munich, Germany.), A. Jansche (Kayser Threde G.m.b.H., Munich, Germany.), J. Merkel (Stuttgart Univ., Germany.), and W. Schaefer (Stuttgart Univ., Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile

Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 147-152 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23535# Kayser Threde G.m.b.H., Munich (Germany).
ON-LINE HEALTH MONITORING: AN INTEGRITY IMPROVEMENT FOR THE CIVIL USE OF GPS AND GLONASS
B. Eissfeller, Martin Haunschild (Maschinenfabrik Augsburg-Nuernberg A.G., Munich, Germany.), A. Jansche, and N. Niklasch (Maschinenfabrik Augsburg-Nuernberg A.G., Munich, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 153-157 (For primary document see N93-23507 08-43)
(Contract ESA(ESTEC)-9281/91)
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05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N93-22486*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AN IMPROVED CAMRAD MODEL FOR AEROELASTIC STABILITY ANALYSIS OF THE XV-15 WITH ADVANCED TECHNOLOGY BLADES
C. W. Acree, Jr. Mar. 1993 56 p
(RTOP 505-59-36)
(NASA-TM-4448; A-92022; NAS 1.15:4448) Avail: CASI HC A04/MF A01

In pursuit of higher performance, the XV-15 Tiltrotor Research Aircraft was modified by the installation of new composite rotor blades. Initial flights with the Advanced Technology Blades (ATB's) revealed excessive rotor control loads that were traced to a dynamic mismatch between the blades and the aircraft control system. The analytical models of both the blades and the mechanical controls were extensively revised for use by the CAMRAD computer program to better predict aeroelastic stability and loads. This report documents the most important revisions and discusses their effects on aeroelastic stability predictions for airplane-mode flight. The ATB's may be flown in several different configurations for research, including changes in blade sweep and tip twist. The effects on stability of 1 deg and 0 deg sweep are illustrated, as are those of twisted and zero-twist tips. This report also discusses the effects of stiffening the rotor control system, which was done by locking out lateral cyclic swashplate motion with shims. Author (revised)

N93-22588*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
JET ENGINE HOT PARTS IR ANALYSIS PROCEDURE (J-EIRP)
Joseph F. Baumeister Feb. 1993 20 p
(RTOP 505-62-00)
(NASA-TM-105914; E-7605; NAS 1.15:105914) Avail: CASI HC A03/MF A01

A thermal radiation analysis method called Jet Engine IR Analysis Procedure (J-EIRP) was developed to evaluate jet engine cavity hot parts source radiation. The objectives behind J-EIRP were to achieve the greatest accuracy in model representation and solution, while minimizing computer resources and computational time. The computer programs that comprise J-EIRP were selected on the basis of their performance, accuracy, and flexibility to solve both simple and complex problems. These programs were intended for use on a personal computer, but include the ability to solve large problems on a mainframe or supercomputer. J-EIRP also provides the user with a tool for developing thermal design experience and engineering judgment through analysis experimentation, while using minimal computer resources. A sample jet engine cavity analysis demonstrates the procedure and capabilities within J-EIRP, and is compared to a simplified method for approximating cavity radiation. The goal is to introduce the terminology and solution process used in J-EIRP and to provide insight into the radiation heat transfer principles used in this procedure. Author (revised)

N93-22799*# Lockheed Engineering and Sciences Co., Hampton, VA.
MULTIDISCIPLINARY OPTIMIZATION OF A CONTROLLED SPACE STRUCTURE USING 150 DESIGN VARIABLES
Benjamin B. James Washington Feb. 1993 22 p
(Contract NAS1-19000; RTOP 506-43-41)
(NASA-CR-4502; NAS 1.26:4502) Avail: CASI HC A03/MF A01

A controls-structures interaction design method is presented. The method coordinates standard finite-element structural analysis, multivariable controls, and nonlinear programming codes and allows simultaneous optimization of the structure and control system of a spacecraft. Global sensitivity equations are used to account for coupling between the disciplines. Use of global sensitivity equations helps solve optimization problems that have a large number of design variables and a high degree of coupling between disciplines. The preliminary design of a generic geostationary platform is used to demonstrate the multidisciplinary optimization method. Design problems using 15, 63, and 150 design variables to optimize truss member sizes and feedback gain values are solved and the results are presented. The goal is to reduce the total mass of the structure and the vibration control system while satisfying constraints on vibration decay rate. Incorporation of the nonnegligible mass of actuators causes an essential coupling between structural design variables and control design variables. Author

N93-22827*# California Univ., Los Angeles. School of Engineering and Applied Science.
CONTROL DESIGN VARIABLE LINKING FOR OPTIMIZATION OF STRUCTURAL/CONTROL SYSTEMS
Ik Min Jin and Lucien A. Schmit Washington Feb. 1993 185 p
(Grant NsG-1490; RTOP 505-63-10-02)
(NASA-CR-4493; NAS 1.26:4493) Avail: CASI HC A09/MF A02

A method is presented to integrate the design space of structural/control system optimization problems in the case of linear state feedback control. Conventional structural sizing variables and elements of the feedback gain matrix are both treated as strictly independent design variables in optimization by extending design variable linking concepts to the control gains. Several approximation concepts including new control design variable linking schemes are used to formulate the integrated structural/control optimization problem as a sequence of explicit nonlinear mathematical programming problems. Examples which involve a variety of behavior constraints, including constraints on dynamic stability, damped frequencies, control effort, peak transient displacement, acceleration, and control force limits, are effectively solved by using the method presented. Author (revised)

N93-23047*# North Carolina State Univ., Raleigh.
DYNAMIC RESPONSE CHARACTERISTICS OF TWO TRANSPORT MODELS TESTED IN THE NATIONAL TRANSONIC FACILITY
Clarence P. Young, Jr. Feb. 1993 34 p
(Contract NCC1-141; RTOP 505-59-85-01)
(NASA-CR-191420; NAS 1.26:191420) Avail: CASI HC A03/MF A01

This paper documents recent experiences with measuring the dynamic response characteristics of a commercial transport and a military transport model during full scale Reynolds number tests in the National Transonic Facility. Both models were limited in angle of attack while testing at full scale Reynolds number and cruise Mach number due to pitch or stall buffet response. Roll buffet (wing buzz) was observed for both models at certain Mach numbers while testing at high Reynolds number. Roll buffet was more severe and more repeatable for the military transport model at cruise Mach number. Miniature strain-gage type accelerometers were used for the first time for obtaining dynamic data as a part of the continuing development of miniature dynamic measurements instrumentation for cryogenic applications. This paper presents the results of vibration measurements obtained for both the commercial and military transport models and documents the experience gained in the use of miniature strain gage type accelerometers. Author (revised)

N93-23186*# Princeton Univ., NJ. School of Engineering and Applied Science.

AN ANALYTIC MODELING AND SYSTEM IDENTIFICATION STUDY OF ROTOR/FUSELAGE DYNAMICS AT HOVER

Steven W. Hong (United Technologies Research Center, East Hartford, CT.) and H. C. Curtiss, Jr. 26 Feb. 1993 21 p Presented at Piloting Vertical Flight Aircraft: A Conference on Flying Qualities and Human Factors, San Francisco, CA, 1993

(Grant NAG2-561)

(NASA-CR-192303; NAS 1.26:192303) Avail: CASI HC A03/MF A01

A combination of analytic modeling and system identification methods have been used to develop an improved dynamic model describing the response of articulated rotor helicopters to control inputs. A high-order linearized model of coupled rotor/body dynamics including flap and lag degrees of freedom and inflow dynamics with literal coefficients is compared to flight test data from single rotor helicopters in the near hover trim condition. The identification problem was formulated using the maximum likelihood function in the time domain. The dynamic model with literal coefficients was used to generate the model states, and the model was parametrized in terms of physical constants of the aircraft rather than the stability derivatives resulting in a significant reduction in the number of quantities to be identified. The likelihood function was optimized using the genetic algorithm approach. This method proved highly effective in producing an estimated model from flight test data which included coupled fuselage/rotor dynamics. Using this approach it has been shown that blade flexibility is a significant contributing factor to the discrepancies between theory and experiment shown in previous studies. Addition of flexible modes, properly incorporating the constraint due to the lag dampers, results in excellent agreement between flight test and theory, especially in the high frequency range. Author

N93-23363# Construcciones Aeronauticas S.A., Madrid (Spain).

SAENGER: A SPACE TRANSPORTATION SYSTEM FOR THE 21ST CENTURY [SAENGER: UN SISTEMA DE TRANSPORTE ESPACIAL PARA EL SIGLO XXI]

Jose Antonio MartinezCabeza 1991 11 p Repr. from Revista de Aeronautica y Astronautica, May 1991 p 536-546 In SPANISH

(ETN-93-93696) Avail: CASI HC A03/MF A01

A report on the German Saenger spaceplane system is presented. Saenger must be able to carry payloads into space at a lower cost than that offered by the Ariane 5/Hermes system, and must also be a basis for hypersonic passenger transportation. The first concept, designated EHTV (Eurepean Hypersonic Transport Vehicle) is described. A discussion on Saenger versus the NASP (National Aero Space Plane) of NASA is included. ESA

N93-23372# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

A CONCEPTUAL DESIGN ANALYSIS OF AN AIR LAUNCHED ANTI-SATELLITE MISSILE SYSTEM M.S. Thesis

G. K. Wishart 1991 228 p

(ETN-93-93487) Copyright Avail: CASI HC A11/MF A03

A project to carry out a conceptual design study for an air launched missile system to intercept low Earth orbit reconnaissance satellites is presented. A historical review of U.S. and Soviet antisatellite programs is given. The target satellite is defined and the various methods of interception, using an air launched missile system, are considered. Using the calculated satellite parameters and assumed missile launch parameters, the missile performance criteria are developed in terms of missile range, weight, latax capability and velocity. Analysis tools developed during the project are used to assess the various design options in terms of missile performance and where possible an optimum design is proposed. The analysis covers the missile propulsion system, missile control, missile guidance and the need for and selection of a warhead. The proposed missile design and the major assumptions made during the analysis are validated. In particular, the assumption that drag could be neglected from the performance calculations is assessed using a specially developed missle trajectory analysis program. The results of the analysis are discussed, highlighting the problem areas encountered and suggesting areas for possible future work. ESA

N93-23401# Aeritalia S.p.A., Rome (Italy). Gruppo Aerei Trasporto.

REVIEW OF AERONAUTICAL FATIGUE INVESTIGATION ACTIVITIES DEVELOPED IN AERITALIA-GAT DURING THE PERIOD MAY 1987 - APRIL 1989

A. Minuto Apr. 1989 9 p Presented at 4th AIFA Meeting, Milan, Italy, 10-11 Apr. 1989

(ETN-93-93702) Avail: CASI HC A02/MF A01

A summary of the main activities of the Aeritalia GAT (Italian acronym for air transport group) in the field of aeronautical fatigue is presented. These include the following: fatigue tests for G222 Cargo door hooks; ATR 42/72 full scale (aircraft, horizontal tail, main landing gear and support, foreward/after entry door plug type, cockpit pressure, and carbon/epoxy pressure dome) tests; the MD-11 full scale winglet assembly fatigue test; and specimen fatigue tests (crack propagation, bonded structures, carbon/epoxy solid laminates, cold working effects on 7050-T73 material). ESA

N93-23416# Construcciones Aeronauticas S.A., Madrid (Spain).

MD-11: WHEN APPEARANCES DECEIVE [MD-11: CUANDO LAS APARIENCIAS ENGANAN]

Jose Antonio MartinezCabeza 1991 12 p Repr. from Revista de Aeronautica y Astronautica, Jul. - Aug. 1991 p 656-667 In SPANISH

(ETN-93-93695) Avail: CASI HC A03/MF A01

A report on the (McDonnell Douglas) MD-11 aircraft is presented. The principle objective of the MD-11 design was to create a more economic aircraft than the DC-10. Spanish aeronautical industry involvement is discussed. The principle characteristics of the MD-11 are given. Interior configurations, the flight cabin system, and the engines and consumption are described. An outline of the MD-12X program is included. ESA

N93-23482# Wright Lab., Wright-Patterson AFB, OH.

WORKSHOP ON TRAJECTORY OPTIMIZATION METHODS AND APPLICATIONS: PRESENTATIONS FROM THE 1992 AIAA ATMOSPHERIC FLIGHT MECHANICS CONFERENCE Final Report, period ending 10 Aug. 1992

Harry A. Karasopoulos and Kevin J. Langan Nov. 1992 111 p

(AD-A259761; WL-TR-92-3112) Avail: CASI HC A06/MF A02

This report is a compilation of presentations from the Workshop on Trajectory Optimization Methods and Applications, at the AIAA Atmospheric Flight Mechanics Conference, Hilton Head, South Carolina, on 10 Aug 1992. GRA

N93-23505 Washington Univ., Seattle.

CFD-BASED APPROXIMATION CONCEPTS FOR AERODYNAMIC DESIGN OPTIMIZATION WITH APPLICATION TO A 2-D SCRAMJET VEHICLE Ph.D. Thesis

Peter David McQuade 1992 103 p

Avail: Univ. Microfilms Order No. DA9239471

This dissertation investigates the application of approximation concepts to aerodynamic optimization. Such techniques, which are gaining popularity in structural optimization, offer the potential of providing the accuracy of a high-fidelity 'detailed' analysis model at greatly reduced computational cost. This is because the detailed model is used only to 'fine-tune' an approximate model which is then used in the optimizer. The test problem treated is the design optimization of a 2-D scramjet vehicle flying at Mach 6.0 at 30 km altitude. The objective function is net thrust. The following approximation concepts are used: the Taylor series approximation to wall pressures and inlet plane flow properties; and Haftka's Global-Local Approximation applied to the same variables. The performance of these techniques is compared to that for optimizing using CFD alone. Cost reductions are quantified. It is shown that modifications must be made to the formulation of the approximation concepts as they are used in structural optimization, due to the changing grid geometries required by the CFD solver. All correction factors for the approximation concept are applied not to the CFD grid points, but to a constant, dense, nondimensionalized 'correction point grid', which does not change as the CFD grid changes. It is also shown that, in areas where discontinuous phenomena are not important (such as the scramjet nozzle), the approximation concepts can be successfully used, after this modification is made. Optimizations of the nozzle region show that all the approximation concepts result in a 68 percent reduction in the number of calls to the CFD solver. In regions dominated by shock impingements (such as the forebody/inlet), it is found that approximation

concepts applied to point properties cannot be used as they currently are in structural optimization, due to the effects of shock movement during correction factor calculations, and due to artifacts of the CFD solver, such as shock smearing. In fact, even though the CFD and the (uncorrected) approximate models optimize to very nearly the same design, the Taylor series and GLA fail to do so. However, application of the GLA to the integrated objective function (net thrust) with zeroth-order correction factors, is unsuccessful. To lay the groundwork for future investigation, a method of improving the behavior of the point-property GLA in the presence of shock impingements is developed and tested. This involves using 'floating' pre- and post-shock coordinate systems for each wall surface. The result is a dramatic reduction in the erratic behavior of the GLA. This technique may form the basis of a generally-applicable GLA technique for aerodynamic optimization. Dissert. Abstr.

N93-23678 National Academy of Sciences - National Research Council, Washington, DC.

VULNERABILITY ASSESSMENT OF AIRCRAFT: A REVIEW OF THE DEPARTMENT OF DEFENSE LIVE FIRE TEST AND EVALUATION PROGRAM

1993 102 p

(PB93-149946) Copyright Avail: Issuing Activity

As a consequence of the reluctance by DOD to conduct realistic live fire tests on systems in development, Congress passed legislation in fiscal year 1987 that requires realistic vulnerability testing of covered weapon systems, including aircraft, before they can proceed beyond Low Rate Initial Production. The legislation is known as the Live Fire Test (LFT) Law. The realistic vulnerability tests mandated by the LFT Law must be conducted on the system, configured for combat, using weapons likely to be encountered in combat. A waiver from these mandated tests is possible if the Secretary of Defense certifies to Congress, prior to entry into engineering and manufacturing development, that such tests are unreasonably expensive and impractical. An alternate plan for assessing vulnerability must be submitted if a waiver to the mandated system tests is given. In an attempt to resolve the controversy regarding the law's requirements, and to obtain an independent opinion regarding the total vulnerability assessment process and the law's contribution to that process, the DDDR&E(T&E), now the Director, Test, and Evaluation, requested that the National Research Council (NRC) conduct a study of aircraft vulnerability assessment. The NRC appointed the Committee on Weapons Effects on Airborne Systems to conduct the study. The report is the result of the committee's deliberations. GRA

N93-23969# Alenia Aeronautica, Pomigliano D'Arco (Italy). Gruppo Aerei Trasporto.

THE ROLE OF FATIGUE TESTING IN THE DESIGN, DEVELOPMENT, AND CERTIFICATION OF THE ATR 42/72

A. Minuto, S. Scafaro, A. Lanciotti (Pisa Univ., Italy.), and L. Lazzeri (Pisa Univ., Italy.) 1991 21 p

(ETN-93-93704) Avail: CASI HC A03/MF A01

The main lines of the test programs followed for the certification of the ATR 42/72 commuter aircraft concerning the fatigue design are described. A large number of experiments are discussed. The approach followed in defining the load spectra, the criteria for loading sequence construction, and the necessary approximation (truncation and omission), required to carry out the tests in the most convenient way are described. Some of the main problems encountered in the full scale test are discussed. ESA

N93-24074# Cranfield Inst. of Tech., Bedford (England). Flight Dynamics and Control Group.

A SIMULATION OF THE BOEING B-747 AIRCRAFT

A. P. Oliva and M. V. Cook Jan. 1992 130 p

(Cranfield-Aero-9202; ISBN-1-871564453X; ETN-93-93554) Avail: CASI HC A07/MF A02; Cranfield Inst. of Technology, Coll. of Aeronautics, Cranfield, Bedford MK43 OAL, United Kingdom, HC

A computer simulation model of the Boeing B-747 aircraft intended for use as a general purpose tool for research into advanced flight control systems for civil aircraft is described. A previous model was adapted with little change and implemented in the Advanced Continuous Simulation Language (ACSL) for use on an appropriate personal computer. Three distinct computer models of the aircraft were produced: a decoupled linear longitudinal model; a decoupled linear lateral directional model; and a fully coupled nonlinear model. ESA

N93-24108*# Vigyan Research Associates, Inc., Hampton, VA.

ANALYSIS OF A HIGH SPEED CIVIL TRANSPORT CONFIGURATION AT SUBSONIC FLOW CONDITIONS USING A NAVIER-STOKES SOLVER Final Report

Victor R. Lessard Washington Feb. 1993 41 p

(Contract NAS1-18585; RTOP 537-03-22-02)

(NASA-CR-4490; NAS 1.26:4490) Avail: CASI HC A03/MF A01

Computations of three dimensional vortical flows over a generic High Speed Civil Transport (HSCT) configuration with an aspect ratio of 3.04 are performed using a thin-layer Navier-Stokes solver. The HSCT cruise configuration is modeled without leading or trailing edge flap deflections and without engine nacelles. The flow conditions, which correspond to tests done in the NASA Langley 8-Foot Transonic Pressure Tunnel (TPT), are a subsonic Mach number of 0.3 and Reynolds number of 4.4 million for a range-of-attack (-.23 deg to 17.78 deg). The effects of the farfield boundary location with respect to the body are investigated. The boundary layer is assumed turbulent and simulated using an algebraic turbulence model. The key features of the vortices and their interactions are captured. Grid distribution in the vortex regions is critical for predicting the correct induced lift. Computed forces and surface pressures compare reasonably well with the experimental TPT data. Author (revised)

N93-24211 Bristol Univ. (England).

A TWO-DIMENSIONAL SPOILER OF ARBITRARY CHORDWISE POSITION IN A LOW SPEED FLOW Ph.D. Thesis

Paul G. Myers 1990 230 p

Avail: Univ. Microfilms Order No. BRDX97389

A study has been carried out at low speeds--with a typical Reynolds Number based on chord of 0.56 x 10(exp 6)--into the static characteristics of a nominally two-dimensional spoiler (to be precise, full span and fitted to a wing with large endplates). The spoiler was of height 0.08c (c being chord), at a selection of chordwise positions and at nominal spoiler deflections of 20 deg and 40 deg. This has helped to clarify the results from two complementary studies, each with a similar spoiler but capable of rapid deployment rates. The current study had the spoiler mounted at one of two chordwise positions: forward (at x/c = 0.15) and mid chord (at x/c = 0.50)--whereas a previous study was for a rear spoiler (at x/c = 0.70). Static and dynamic spoiler characteristics are strongly dependent on configuration--incidence (alpha), spoiler projected height and chordwise position--this set of three having a crucial role in determining whether the flow that separates from the spoiler free edge reattaches forward of the trailing edge or extends into the wake. Only the latter flow allows the spoiler to be fully effective. As regards static results, over the viable incidence range (chosen so that the spoiler is effective) a mid chord spoiler is almost equally effective at all alpha whereas a forward spoiler is most effective at high positive alpha and a rear spoiler is most effective at high negative alpha. Surprisingly, the contribution to lift spoiling from the surface opposite the spoiler is generally greater than that from the surface including the spoiler. A rapidly opening spoiler generates a spoiler starting vortex which may lead to a transient increase in lift when the ultimate quasi-steady change is a decrease. This is known as an adverse effect and is strongly dependent on spoiler chordwise location. The other possible transient feature observed is an overshoot during which the maximum recorded transient decrease in lift is much larger than the quasi-steady decrease. A rapidly closing spoiler causes a surge of higher pressure air to be dispelled in the flow direction and this may cause an adverse effect if the spoiler is located far enough forward. Aerodynamic performance is strongly dependent on the distance, d, from spoiler free edge to trailing edge. With U denoting freestream velocity and T the spoiler opening time, UT/d is a more useful parameter than UT/c in comparing spoilers of different chordwise locations. Dissert. Abstr.

N93-24430# Wright State Univ., Dayton, OH.

MULTIOBJECTIVE OPTIMIZATION OF AEROSPACE STRUCTURES Final Report, 1 Jan. 1990 - 31 Dec. 1991

Ramana V. Grandhi and Geetha Bharatram Jul. 1992 130 p

(Contract F33615-88-C-3204)

(AD-A260433; WL-TR-92-3052) Avail: CASI HC A07/MF A02

This report presents the multiobjective optimization methodology suitable

to the preliminary design of large scale aircraft structures. The algorithm is based on generalized compound scaling techniques to reach the intersection of multiple functions. Multiobjective functions are treated similar to the behavior constraints by generating pseudo-targets on objectives. This algorithm is very efficient due to the fact that it does not solve many single objective optimization problems in reaching the Pareto set. The Pareto set gives several optimum solutions, and the designer has to use additional decision criteria in selecting the best design. In this work, a reliability index based concept is used as the decision criterion. System reliability of the Pareto designs is calculated-due to the random nature of material properties, fabrication tolerances, and service loads, where the random parameters influencing the design appear through their mean and covariance values. GRA

N93-24481*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
USE OF SYSTEM IDENTIFICATION TECHNIQUES FOR IMPROVING AIRFRAME FINITE ELEMENT MODELS USING TEST DATA Final Report
Sathya V. Hanagud, Weiyu Zhou, James I. Craig, and Neil J. Weston Mar. 1993 112 p
(Grant NAG1-1007)
(NASA-CR-192699; NAS 1.26:192699; E-16-A22) Avail: CASI HC A06/MF A02

A method for using system identification techniques to improve airframe finite element models using test data was developed and demonstrated. The method uses linear sensitivity matrices to relate changes in selected physical parameters to changes in the total system matrices. The values for these physical parameters were determined using constrained optimization with singular value decomposition. The method was confirmed using both simple and complex finite element models for which pseudo-experimental data was synthesized directly from the finite element model. The method was then applied to a real airframe model which incorporated all of the complexities and details of a large finite element model and for which extensive test data was available. The method was shown to work, and the differences between the identified model and the measured results were considered satisfactory. Author (revised)

N93-24535*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AN EXPERIMENTAL INVESTIGATION OF SUBSONIC FLOW IN A TWO-DIMENSIONAL U-DUCT (Diskette Supplement)
Daryl J. Monson and H. Lee Seegmiller Jul. 1992 108 p Diskette supplement: IBM compatible 3.5-inch DSDD
(RTOP 505-59-53)
(NASA-TM-103931; A-92087; NAS 1.15:103931;
NONP-Suppl-DK-93-159802) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A13

An experimental study of the low speed internal flow in a two-dimensional strongly-curved U-duct was conducted in order to acquire fluid dynamic data suitable for evaluating numerical-flow codes. The measurements include surface oil-flow patterns, static pressure distributions obtained with an electronically scanned pressure system, mean and turbulent velocity profiles acquired with laser-Doppler velocimetry, and surface skin friction measured with a laser interferometer skin friction method. The tests were performed at an average Mach number of 0.1, and at Reynolds numbers (based on channel height) of 1 x 10(exp 5) and 1 x 10(exp 6). A high-aspect-ratio geometry together with sidewall boundary-layer suction panels was employed to minimize wall interference effects and obtain nominally two-dimensional flow data. Data files generated are included on a 3.5-inch low-density diskette. Author (revised)

N93-24591 Ministry of Communications, Ottawa (Ontario).
MICROWAVE-POWERED AIRCRAFT Patent
John F. Martin, inventor (to Ministry of Communications), James D. DeLaurier, inventor (to Ministry of Communications), George W. Jull, inventor (to Ministry of Communications), and Arne Lillemark, inventor (to Ministry of Communications) 28 Jan. 1992 18 p Filed 24 Nov. 1987
(CA-Patent-1-295-019; Int-Patent-Class-B64C-39/02; CTN-93-60635)
Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC

A microwave powered aircraft is presented. This patent discusses a method for propelling the aircraft by means of microwave energy received by a rectenna. The rectenna is mounted on the underside of a relatively shallow body attached to the underside of the aircraft. The major dimensions of the body extend horizontally and its periphery is vertically curved so as to reduce turbulence in the airstream over the body during flight. The body is separate from the lifting means of the aircraft and is shaped to avoid generation of lift by the body. The lifting surfaces are comprised of wings located forward of the microwave receiving body, which may in that case serve as means for promoting longitudinal stability of the aircraft. The aircraft includes a fuselage with a movable canard located forward of the lifting surfaces, or conventional tail surfaces of the fuselage, for promoting longitudinal stability. A pylon of symmetrical airfoil cross-section is preferably mounted on the fuselage to support the wings. The pylon includes a flap at its trailing edge to cause a side force to act on the aircraft independently of the bank angle of the aircraft. The control of such a surface in conjunction with the aircraft's other control surfaces can produce turns with relatively small bank angles. Author (CISTI)

N93-23943 Institute for Aerospace Research, Ottawa (Ontario). Structures and Materials Lab.
A REVIEW OF DESIGN AND MANUFACTURING METHODOLOGIES FOR STIFFENED COMPOSITE PANELS USED IN AIRCRAFT
F. Elaldi, S. Lee, and R. F. Scott *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 103-125 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N93-23102*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
FLIGHT EXPERIENCE WITH LIGHTWEIGHT, LOW-POWER MINIATURIZED INSTRUMENTATION SYSTEMS
Philip J. Hamory and James E. Murray Washington Mar. 1993 18 p Presented at the AIAA 6th Biennial Flight Test Conference, Hilton Head, SC, 24-26 Aug. 1992 Previously announced in IAA as A93-11280
(RTOP 505-59-54)
(NASA-TM-4463; H-1879; NAS 1.15:4463; AIAA Paper 92-4111) Avail: CASI HC A03/MF A01

Engineers at the NASA Dryden Flight Research Facility (NASA-Dryden) have conducted two flight research programs with lightweight, low-power miniaturized instrumentation systems built around commercial data loggers. One program quantified the performance of a radio-controlled model airplane. The other program was a laminar boundary-layer transition experiment on a manned sailplane. NASA-Dryden personnel's flight experience with the miniaturized instrumentation systems used on these two programs is reported. The data loggers, the sensors, and the hardware and software developed to complete the systems are described. How the systems were used is described and the challenges encountered to make them work are covered. Examples of raw data and derived results are shown as well. Finally, future plans for these systems are discussed. For some flight research applications where miniaturized instrumentation is a requirement, the authors conclude that commercially available data loggers and sensors are viable alternatives. In fact, the data loggers and sensors make it possible to gather research-quality data in a timely and cost-effective manner. Author (revised)

N93-23175*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
FIBER-OPTIC INTERFEROMETRIC SENSORS FOR MEASUREMENTS OF PRESSURE FLUCTUATIONS: EXPERIMENTAL EVALUATION
Y. C. Cho and P. T. Soderman Jan. 1993 14 p

(RTOP 505-59-54)
(NASA-TM-104002; A-93042; NAS 1.15:104002) Avail: CASI HC A03/MF A01

This paper addresses an anechoic chamber evaluation of a fiber-optic interferometric sensor (fiber-optic microphone), which is being developed at NASA Ames Research Center for measurements of pressure fluctuations in wind tunnels. Author

N93-23408*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CONCEPTS FOR CONFORMAL AND BODY-AXIS ATTITUDE INFORMATION FOR SPATIAL AWARENESS PRESENTED IN A HELMET-MOUNTED DISPLAY
Denise R. Jones, Terence S. Abbott, and James R. Burley, II Washington Mar. 1993 11 p
(RTOP 505-68-30-09)
(NASA-TM-4438; L-17125; NAS 1.15:4438) Avail: CASI HC A03/MF A01

A piloted simulation study has been conducted to evaluate two methods of presenting attitude information in a helmet-mounted display (HMD) for spatial awareness in a fighter airplane. One method, the body-axis concept, displayed the information relative to the body axis of the airplane. The quantitative results of this study favored the body-axis concept. Although no statistically significant differences were noted for either the pilots' understanding of roll attitude or target position, the pilots made pitch judgment errors three times more often with the conformal display. The subjective results showed the body-axis display did not cause attitude confusion, a prior concern with this display. In the posttest comments, the pilots overwhelmingly selected the body-axis display as the display of choice. Author

N93-24416# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, OH.
OPERATOR INTERFACE ASSESSMENT FOR THE SENSOR FUSION FLIGHT DEMONSTRATION PROGRAM Final Report, Jul. 1991 - Jul. 1992
Gilbert G. Kuperman Sep. 1992 63 p
(AF Proj. 7184)
(AD-A260235; AL-TR-1992-0117) Avail: CASI HC A04/MF A01

Multiple sensors were flown during an avionics integration flight demonstration. A millimeter wave radar with an automatic target cuer was employed to perform real-time concealed critical mobile target detection. Forward looking infrared and laser line scan sensors were used to support target confirmation. An operator interface was designed and evaluated by operational command subject matter experts. An automated sensor management system was used to reduce crew workload. GRA

N93-22028# Dornier System G.m.b.H., Friedrichshafen (Germany).
THE AVIONIC SYSTEM OF THE EXPERIMENTAL STANDOFF DISPENSER ADW
Juergen Scheuch *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 6 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A02/MF A02

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N93-22034* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MULTI-HEAT ADDITION TURBINE ENGINE Patent
Leo C. Franciscus, inventor (to NASA) and Theodore A. Brabbs, inventor (to NASA) 9 Feb. 1993 7 p Filed 30 Jan. 1991 Supersedes N91-23180 (29 - 15, p 2381)
(NASA-Case-LEW-15094-1; US-Patent-5,184,460; US-Patent-Appl-SN-647902; US-Patent-Class-60-226.1; US-Patent-Class-60-39.17; Int-Patent-Class-F02K-3/04; Int-Patent-Class-F02K-3/08) Avail: US Patent and Trademark Office

A multi-heat addition turbine engine (MHATE) incorporates a plurality of heat addition devices to transfer energy to air and a plurality of turbines to extract energy from the air while converting it to work. The MHATE provides dry power and lower fuel consumption or lower combustor exit temperatures. Official Gazette of the U.S. Patent and Trademark Office

N93-22480*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A FULL-SCALE STOVL EJECTOR EXPERIMENT
Wendy S. Barankiewicz Feb. 1993 134 p
(RTOP 505-68-32)
(NASA-TM-106019; E-7433-1; NAS 1.15:106019) Avail: CASI HC A07/MF A02

The design and development of thrust augmenting short take-off and vertical landing (STOVL) ejectors has typically been an iterative process. In this investigation, static performance tests of a full-scale vertical lift ejector were performed at primary flow temperatures up to 1560 R (1100 F). Flow visualization (smoke generators, yarn tufts and paint dots) was used to assess inlet flowfield characteristics, especially around the primary nozzle and end plates. Performance calculations are presented for ambient temperatures close to 480 R (20 F) and 535 R (75 F) which simulate 'seasonal' aircraft operating conditions. Resulting thrust augmentation ratios are presented as functions of nozzle pressure ratio and temperature. Full-scale experimental tests such as this are expensive, and difficult to implement at engine exhaust temperatures. For this reason the utility of using similarity principles -- in particular, the Munk and Prim similarity principle for isentropic flow -- was explored. At different primary temperatures, exit pressure contours are compared for similarity. A nondimensional flow parameter is then shown to eliminate primary nozzle temperature dependence and verify similarity between the hot and cold flow experiments. Under the assumption that an appropriate similarity principle can be established, then properly chosen performance parameters should be similar for both hot flow and cold flow model tests. Author (revised)

N93-22599*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MATHEMATICAL RELATIONSHIP BETWEEN TWO SETS OF LASER ANEMOMETER MEASUREMENTS FOR RESOLVING THE TOTAL VELOCITY VECTOR
Albert K. Owen Mar. 1993 20 p
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-105986; E-7511; NAS 1.15:105986; AVSCOM-92-C-038) Avail: CASI HC A03/MF A01

The mathematical relations between the measured velocity fields for the same compressor rotor flow field resolved by two fringe type laser anemometers at different observational locations are developed in this report. The relations allow the two sets of velocity measurements to be combined to produce a total velocity vector field for the compressor rotor. This report presents the derivation of the mathematical relations, beginning with the specification of the coordinate systems and the velocity projections in those coordinate systems. The vector projections are then transformed into a common coordinate system. The transformed vector coordinates are then combined to determine the total velocity vector. A numerical example showing the solution procedure is included. Author

N93-22735# Dayton Univ., OH. Research Inst.
COMBUSTION AND HEAT TRANSFER STUDIES UTILIZING ADVANCED DIAGNOSTICS: COMBUSTION DATA SETS Final Report, 11 Sep. 1987 - 30 Sep. 1992
D. R. Ballal, S. P. Heneghan, W. J. Schmoll, F. Takahashi, and M. D. Vangsness Nov. 1992 183 p
(Contract F33615-87-C-2767)
(AD-A260211; WL-TR-92-2111) Avail: CASI HC A09/MF A02

A long-term goal of the Air Force is to develop near-stoichiometric gas turbine combustors that will burn broad-specification fuels, and have low maintenance and high durability. Towards meeting this goal, this program had two principal objectives: to design and conduct experiments that will establish a fundamental understanding of lean blowout (LBO), swirling flames, kinetically controlled combustion, and turbine blade cooling, and to provide

data sets for evaluating and refining computer models of gas turbine combustor. In this final report, we present the Combustion Data Sets that may be used by modelers in the industry and other laboratories for evaluating and refining computer models of gas turbine combustor. These data sets are for three different technical tasks: step combustor task, bluff body combustor task, and swirl combustor task. More exhaustive information is available in the individual papers listed in this report. All the data sets were prepared using Microsoft Excel V.4.0 for IBM PC-Compatible computers and are available on computer diskettes. GRA

N93-23013*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

STUDY OF THE CAPACITANCE TECHNIQUE FOR MEASURING HIGH-TEMPERATURE BLADE TIP CLEARANCE ON CERAMIC ROTORS

John P. Barranger Mar. 1993 17 p

(RTOP 510-01-50)

(NASA-TM-105978; E-7502; NAS 1.15:105978) Avail: CASI HC A03/MF A01

Higher operating temperatures required for increased engine efficiency can be achieved by using ceramic materials for engine components. Ceramic turbine rotors are subject to the same limitations with regard to gas path efficiency as their superalloy predecessors. In this study, a modified frequency-modulation system is proposed for the measurement of blade tip clearance on ceramic rotors. It is expected to operate up to 1370 C (2500 F), the working temperature of present engines with ceramic turbine rotors. The design of the system addresses two special problems associated with nonmetallic blades: the capacitance is less than that of a metal blade and the effects of temperature may introduce uncertainty with regard to the blade tip material composition. To increase capacitance and stabilize the measurement, a small portion of the rotor is modified by the application of 5-micron-thick platinum films. The platinum surfaces on the probe electrodes and rotor that are exposed to the high-velocity gas stream are coated with an additional 10-micron-thick protective ceramic topcoat. A finite-element method is applied to calculate the capacitance as a function of clearance. Author

N93-23371# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

CONCEPTUAL DESIGN STUDY OF A VARIABLE CYCLE ENGINE FOR A SUPERSONIC BUSINESS JET M.S. Thesis

Luke Brown 1992 149 p

(ETN-93-93486) Avail: CASI HC A07/MF A02

The aim of this project was to produce an engine cycle for both subsonic and supersonic flight conditions that could be produced by the variation of bypass ratio. The basic aircraft and flight profiles are defined followed by the initial conditions of the engine. The starting point, the takeoff, subsonic cruise and supersonic cruise engine cycles are studied. For each of these conditions carpet plots are produced for a range of bypass ratios, turbine entry temperatures, and engine pressure ratios. A selection is made of the most suitable engine cycle for the takeoff condition taking into account jet velocity restrictions. A selection is also made of the most suitable engine cycle for the supersonic condition. Their compatibility was then studied. The results indicated that the two engine cycles were compatible and therefore could be produced by the same engine by the variation of the bypass ratio. The effect of the engine cycle selection on the dimensions of the engine are examined and a schematic diagram of the engine layout is produced. Methods of varying the engine cycle are discussed and compared with the results of this study. There are certain aspects of the engine design which are not entirely satisfactory. Methods by which the design might be improved are discussed. ESA

N93-23391# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).

NEW APPROACHES FOR A SECOND GENERATION SUPERSONIC TRANSPORT PROPULSION SYSTEM

Pascal J. Senechal 1991 13 p Presented at 2nd International Aerospace Symposium, Tokyo, Japan, Feb. 1991

(DS-1934; ETN-93-93374) Avail: CASI HC A03/MF A01

Views on cruise Mach number, environmental issues, and relevant engine concepts proposed for a second generation SST (Supersonic Transport), from experience in the development, manufacture, and support of supersonic civil powerplants are presented. The flexibility of the variable cycle engine concepts in meeting the major environmental issues is discussed, and a technology acquisition plan is proposed. Confidence in the variability of a second generation SST is concluded from commercial supersonic operations and a demonstrated safety record. However, to meet noise requirements and future NO(x) standards, variable cycle engines and ultra low NO(x) emission combustor, which require a high effort in technology acquisition and will need demonstration before committing to a full scale development, must be developed. It is anticipated that this effort will lead to worldwide international cooperation. ESA

N93-23669# Boeing Defense and Space Group, Seattle, WA.

X RAY COMPUTED TOMOGRAPHY FOR WHOLE SYSTEM EVALUATION (SMALL ENGINES) Interim Report, Jun. 1990 - Feb. 1991

Alan R. Crews and Richard H. Bossi 31 May 1992 52 p

(Contract F33615-88-C-5404)

(AD-A259519; WL-TR-91-4109) Avail: CASI HC A04/MF A01

Under a preliminary testing task assignment of the Advanced Development of X-Ray Computed Tomography Application Program, computed tomography (CT) has been studied for its potential as an engineering analysis tool and an in-service nondestructive evaluation method for whole systems such as small jet engines. CT evaluation has been employed on small jet engines demonstrating its viability for assembly verification, dimensional profiles, and foreign object detection without disassembly. CT systems with energies of 400 kV, 2 MV, 2.5 MV, and 9 MV were used in the study. The sensitivity to feature details in complex systems, such as the jet engines, is improved with higher signal to noise for the same inherent resolution. For long metal paths, the highest energy available is preferred, however many of the 2 MV images showed good sensitivity to internal details, and even 400 kV can be usefully employed in some regions of an engine. The quantitative capability of CT to measure the relative x-ray linear attenuation coefficient and position of small volume elements in an object offers the potential to directly calculate the center-of-gravity (CG) of the object from the CT scan data. Results of CT tests on a test phantom indicates that under certain conditions CG calculations can be made for CT data with sensitivity on the order of 0.15 g-cm in aluminum at 3 cm radius. GRA

N93-24002# Gas Turbine Society of Japan, Tokyo.

PROBLEMS ON NUMERICAL ANALYSIS RELATING TO GAS TURBINES

31 Mar. 1992 171 p In JAPANESE

(DE93-753796; ETDE/JP-mf-93753796) Avail: CASI HC A08/MF A02

At the beginning of CFD (Computational Fluid Dynamics) technology, the streamline curvature method was used for design and analysis of the whole system of turbines and compressors. On the contrary, in the cascade flow analysis method, the inviscid cascade analysis based on potentials or Eulerian equations is in a stage of adolescence. The recent three-dimensional viscous flow field analysis including turbulent flow, heat transfer and chemical reaction is in a stage of transfering to maturity. This analysis seems to be a numerical simulation system including flow, heat transfer, chemical reaction and structure strength in the future. In order to construct the design system by the numerical simulation technology, it is necessary for the simulation technology to be improved in stability, accuracy and calculation efficiency, to be established in reliability and to be validated through high-accurate experiments. The paper presents basic problems, application examples, problems to be pointed out and future issues of CFD technology and also refers to peripherally related technology indispensable to development of CFD and subjects and prospects for commercialization. DOE

N93-24176 Carleton Univ., Ottawa (Ontario).

MEASUREMENT AND PREDICTION OF TIP-CLEARANCE EFFECTS IN A LINEAR TURBINE CASCADE Ph.D. Thesis

Metin Ilbay Yaras 1990 402 p

(ISBN-0-315-68826-2) Avail: Univ. Microfilms Order No. DANN68826

Measurements are performed in a stationary linear cascade of turbine blades for a range of clearances varying from 0.0 to 5.5 percent blade chord. The downstream flow field is measured with a seven-hole pressure probe at several axial locations. The results are analyzed both in terms of vorticity and total pressure loss. The former quantity provides insight into several aspects of the leakage flow, including size and strength of the leakage vortex in relation to the tip-clearance size and the bound circulation of the blade; the diffusion rate of the tip-leakage vortex and its interaction

with the passage flow. In this context, a simple model of the vortex based on the diffusion of a line vortex is found to be quite accurate. Evaluation of the losses in the downstream measurement planes in relation to the losses measured inside the tip gap help clarify the dominant tip-leakage loss mechanisms. Based on experimental observations, full verification of existing turbomachinery tip-leakage loss prediction schemes is performed. An improved tip-leakage loss model is developed using one of the existing models as the starting point. Following the stationary linear cascade tests, relative tipwall motion is simulated by a moving belt. Three clearance sizes of 1.5, 2.4 and 3.8 percent blade chord are examined. The tip-gap and downstream flow together with blade pressures are measured for several wall speeds. As the relative wall speed is increased, the mass flow rate through the gap is significantly reduced. The dominant mechanism behind this trend is identified. The relative wall motion alters the tip vortex and passage vortex structures substantially. The trends in the blade loading are found to be in agreement with the observed changes in the vortex structures. Based on the experimental results, the tip-vortex and tip-gap flow models are extended to the case of relative tipwall motion. Succeeding the experimental and theoretical work on tip-leakage flow for plain tip geometry, blade tip treatments to reduce tip-leakage losses are tested with stationary and moving tipwall for clearance sizes of 2.4 and 3.7 percent blade chord. Three types of winglets consisting of pressure-side, suction-side and a combination of the two are considered in comparison to the regular blade tip. Losses extracted from measurements downstream of the blades suggest some reduction of tip-leakage losses with the application of winglets. The possible physical mechanisms by which winglets reduce the losses are discussed on the basis of downstream flow field data and tipwall static pressures. Dissert. Abstr.

N93-24271# Naval Postgraduate School, Monterey, CA.
AIRCRAFT ENGINE RELIABILITY ANALYSIS USING LOWER CONFIDENCE LIMIT ESTIMATE PROCEDURES M.S. Thesis
Richard P. Baldwin 14 Dec. 1992 91 p
(AD-A260386) Avail: CASI HC A05/MF A01

In this thesis, a spreadsheet model was developed to compute the lower confidence limit (LCL) for the reliability of a complex weapon system using a personal computer. The LCL is an estimate of the lowest reliability a system is expected to have at a given point in time with a given level of confidence. The reliability model is based on a Weibull distribution for the system component failure times. The reliability LCL procedures were extensively validated and determined to be quite accurate when the expected number of failures is at least 10. This model is capable of supporting LCL decisions in support of the Component Improvement Program or new weapon system procurement where reliability growth analysis is used as a decision support tool. This procedure also provides program managers and engineers with a method to perform LCL analysis and thereby reduce their dependence on contractor supplied reliability data. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N93-23088*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TRAIL MANEUVER GENERATION AND SELECTION IN THE PALADIN TACTICAL DECISION GENERATION SYSTEM
Alan R. Chappell (Lockheed Engineering and Sciences Co., Hampton, VA.), John W. McManus, and Kenneth H. Goodrich Jan. 1993 13 p Previously announced in IAA as A92-55255
(RTOP 505-64-30-01)
(NASA-TM-107722; NAS 1.15:107722) Avail: CASI HC A03/MF A01

To date, increased levels of maneuverability and controllability in aircraft have been postulated as tactically advantageous, but little research has studied maneuvers or tactics that make use of these capabilities. In order to help fill this void, a real-time tactical decision generation system for air combat engagements, Paladin, has been developed. Paladin models an air combat engagement as a series of discrete decisions. A detailed description of Paladin's decision making process is presented. This includes the sources of data used, methods of generating reasonable maneuvers for the Paladin aircraft, and selection criteria for choosing the 'best' maneuver. Simulation results are presented that show Paladin to be relatively insensitive to errors introduced into the decision process by estimation of future positional and geometric data. Author

N93-23123*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
SUMMARY OF THE EFFECTS OF ENGINE THROTTLE RESPONSE ON AIRPLANE FORMATION-FLYING QUALITIES
Kevin R. Walsh Washington Mar. 1993 26 p Presented at the AIAA 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992 Previously announced in IAA as A92-48902
(RTOP 307-05-01)
(NASA-TM-4465; H-18880; NAS 1.15:4465; AIAA Paper 92-3318) Avail: CASI HC A03/MF A01

A flight evaluation was conducted to determine the effect of engine throttle response characteristics on precision formation-flying qualities. A variable electronic throttle control system was developed and flight-tested on a TF-104G airplane with a J79-11B engine at the NASA Dryden Flight Research Facility. This airplane was chosen because of its known, very favorable thrust response characteristics. Ten research flights were flown to evaluate the effects of throttle gain, time delay, and fuel control rate limiting on engine handling qualities during a demanding precision wing formation task. Handling quality effects of lag filters and lead compensation time delays were also evaluated. The Cooper and Harper Pilot Rating Scale was used to assign levels of handling quality. Data from pilot ratings and comments indicate that throttle control system time delays and rate limits cause significant degradations in handling qualities. Threshold values for satisfactory (level 1) and adequate (level 2) handling qualities of these key variables are presented. These results may provide engine manufacturers with guidelines to assure satisfactory handling qualities in future engine designs. Author

N93-23373# Loughborough Univ. of Technology (England). Dept. of Specialist Ground Training.
BANK-TO-TURN MISSILES AND AUTOPILOT DESIGN M.S. Thesis
T. S. Knill 1990 192 p
(ETN-93-93488) Copyright Avail: CASI HC A09/MF A02

Background information on missile autopilots and bank-to-turn steering is given by covering the following topics: where the autopilots fits into the overall command guidance loop; performance requirements, objectives and design problems; the different types of autopilots and their basic design; and a comparison of bank-to-turn and skid-to-turn steering, outlining the advantages and disadvantages of each and looking at experimental evidence that demonstrates the superior aerodynamic properties of certain asymmetrical missiles over circular bodies. The aerodynamic transfer functions, including some of the cross coupling terms, are derived from first principles to allow a relatively 'simplified' (although still very complex) coupled bank-to-turn autopilot to be designed, modeled and analyzed on MATLAB (a computer software package designed for analysis of control systems in block diagram form) for a specific missile design and operating point. The responses of the missile to specific demands are then found and compared for the missile in a bank-to-turn and skid-to-turn configuration. This exercise demonstrates some of the problems involved in the design of a coupled bank-to-turn autopilot and the implementation of the design on conventional software programs. ESA

N93-24087# Wright Lab., Wright-Patterson AFB, OH.
AN INTRODUCTION TO MULTIVARIABLE FLIGHT CONTROL SYSTEM DESIGN Final Report, Jan. - Oct. 1992
Richard J. Adams, James M. Buffington, Andrew G. Sparks, and Siva S. Banda Oct. 1992 185 p
(AF Proj. 2304)
(AD-A260408; WL-TR-92-3110) Avail: CASI HC A09/MF A02

Background, theory, and examples for full envelope manual flight control system design is presented. An overview of aircraft dynamics and flying qualities is given to provide a basic understanding of the manual flight control problem. Details of available control design and analysis methods are presented to give the reader the required theoretical background. An inner/outer loop control structure is proposed to achieve full envelope flight control designs. Generalized controls are implemented through the

use of a control selector. An inner equalization loop is used to linearize the input/output behavior of the aircraft across the flight envelope. A robust outer loop achieves the desired level of flying qualities. This approach provides a versatile framework for the application of advanced multivariable control theory to aircraft control problems. The engineer has the freedom to choose any method which achieves the design goals. The utility of this controller structure is demonstrated in its successful application to full envelope manual flight control problems for the VISTA F-16 test aircraft and a supermaneuverable F-18 fighter. The results of linear robustness and performance analysis as well as nonlinear simulations are presented for the design examples. GRA

N93-24153# Aeronautical Research Labs., Melbourne (Australia).
VARIABLE CONTROL SYSTEM LIMITS ON BLACK HAWK AND SEAHAWK HELICOPTERS
J. Blackwell, S. Dutton, R. Toffoletto, and J. F. Harvey Oct. 1992 39 p (AD-A259624; ARL-FLIGHT-MECH-R-191; DODA-AR-007-083) Avail: CASI HC A03/MF A01

Black Hawk and Seahawk helicopters have various fixed physical control limits situated throughout the control system. The range of each pilot control is variable and depends on which limit is reached first. This is a function of the pilot control inputs applied, together with any additional control inputs provided by the automatic flight control system. A procedure was developed to monitor controls in the vicinity of each limit, and determine if any part of the control system approaches to within a prescribed amount of a limit. Warning lights in the cockpit inform the pilot if a limit is being approached. The procedure was used effectively during a First of Class Flight Trial involving a Black Hawk. GRA

N93-24228# Department of the Navy, Washington, DC.
REMOTELY PILOTED VEHICLE CONTROL AND INTERFACE SYSTEM Patent Application
Adam J. Simonoff, inventor (to Navy) 3 Sep. 1992 15 p (AD-D015618; US-Patent-Appl-SN-940159; Navy-Case-74060) Avail: CASI HC A03/MF A01

A remotely piloted vehicle control and interface system is provided. A personal computer equipped with an RS232 serial communication port passes an ASCII character(s) as a serial data stream. A shift register device converts the serial data stream to a parallel data character and continuously generates a status signal indicating one of the presence or absence of the parallel data character. A central processing unit, responsive to the status signal, compares the parallel data character with a set of valid control characters to generate a control signal when a match occurs there between. A transmitter, responsive to the control signal, transmits a radio frequency control signal to the remotely piloted vehicle. GRA

N93-24241# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
STABILITY OF ELASTICALLY TAILORED ROTOR SYSTEMS Final Report, 1 Dec. 1988 - 30 Sep. 1992
Dewey H. Hodges, Lawrence W. Rehfield, and Mark V. Fulton 30 Nov. 1992 10 p
(Contract DAAL03-89-K-0007)
(AD-A260550; ARO-25327.6-EG) Avail: CASI HC A02/MF A01

In this work the objectives included: (1) the development of models and analysis methodology for rotor stability in hover, incorporating all relevant nonclassical structural effects; (2) the validation of the models and analysis methodology, including convergence; and (3) the conduct of limited design studies with the tools developed in order to enhance understanding of the role of elastic couplings on stability. All these objectives were met. The final report contains a brief summary description of the results of the work. Details may be found in the published papers listed at the end of the report. GRA

N93-22368*# McDonnell Aircraft Co., Saint Louis, MO.
A NEURAL BASED INTELLIGENT FLIGHT CONTROL SYSTEM FOR THE NASA F-15 FLIGHT RESEARCH AIRCRAFT
James M. Urnes, Stephen E. Hoy, Robert N. Ladage, and James Stewart *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 109-112 Prepared for NASA. Dryden Flight Research Facility, Edwards, CA (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

N93-22369*# Army Aviation Systems Command, Hampton, VA. Aerostructures Directorate.
A TELEOPERATED UNMANNED ROTORCRAFT FLIGHT TEST TECHNIQUE
Gregory W. Walker, Arthur E. Phelps, III, and W. Todd Hodges *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 113-126 (For primary document see N93-22351 08-63)
Avail: CASI HC A03/MF A03

N93-22575*# Princeton Univ., NJ.
DYNAMIC RESPONSE AND CONTROL OF A JET-TRANSPORT AIRCRAFT ENCOUNTERING A SINGLE-AXIS VORTEX
Darin R. Spilman *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 141-150 (For primary document see N93-22561 08-01)
Avail: CASI HC A02/MF A02

N93-22576*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
INTELLIGENT FLIGHT CONTROL SYSTEMS
Robert F. Stengel *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1992-1992 Feb. 1993 p 151-172 Presented at the Aerospace Vehicle Dynamics and Control, Bedford, England, 7-10 Sep. 1992 (For primary document see N93-22561 08-01)
(Contract NGL-31-001-252; DAAL03-89-K-0092)
Avail: CASI HC A03/MF A02

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N93-22393# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.
VISUAL SYSTEM PERFORMANCE FOR DRIVING SIMULATORS
U. Fligge, M. Soodeen, and K. Moebes Apr. 1992 8 p
(MBB-FE-521-S-PUB-0497; ETN-93-93439) Avail: CASI HC A02/MF A01

Visual system features which are necessary in providing effective visual cues to a driver are addressed. A selected number of applications for driver simulators are described and associated to a class of visual systems. A medium class visual system is then used to create a basis for a definition between required driver visual cues and visual system performance and features. Driver simulation application is concluded as presenting a great challenge to the visual system because of its complexity. The variation of requirements demand that the visual system be based upon a modular design (multichannel system, varying channel resolution) and support a range of system features (z buffer, texture, three dimensional fixed/moving objects, footprint elevation, and fading algorithm). Other features which enhance the acceptance of a visual system as an information source for a driver are the scene update rate and video output format. ESA

N93-22666# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Hauptabt. Verkehrsforschung.
A METHOD FOR ESTIMATING FUTURE RUNWAY CAPACITY OF GERMAN AIRPORTS FOR SINGLE RUNWAY SYSTEMS [EIN PROGNOSETAUGLICHES VERFAHREN ZUR ERMITTLUNG DER START- UND LANDEBAHNKAPAZITAETEN DEUTSCHER VERKEHRSFLUGHAEFEN FUER EINBAHNSYSTEME]
Eckhard Urbatzka Oct. 1991 150 p In GERMAN
(DLR-FB-91-38; ETN-93-91927) Avail: CASI HC A07/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A method for estimating runway capacity, defined as the maximum

number of aircraft movements per hour, is presented. The method is based on real flight operations in the airport control zone by means of radar data. The method draws from empirical data of the international airports of the Federal Republic of Germany with their local and operational procedures. Both the total range of possible capacity values and the present respectively, future arrival or departure or arrival-departure capacity may be estimated by means of parameter variation. A comparison of future aircraft movements (forecast) with future runway capacity is therefore possible. In this way it can be ascertained, whether or not the forecast movements can be handled by the runway system of an airport. The method is limited to single runways at the moment; the extension to multiple runways is in process. ESA

N93-22675*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CHARACTERISTICS OF VERTICAL AND LATERAL TUNNEL TURBULENCE MEASURED IN AIR IN THE LANGLEY TRANSONIC DYNAMICS TUNNEL

Robert K. Sleeper, Donald F. Keller, Boyd Perry, III, and Maynard C. Sandford Mar. 1993 58 p

(RTOP 505-63-50-15)

(NASA-TM-107734; NAS 1.15:107734) Avail: CASI HC A04/MF A01

Preliminary measurements of the vertical and lateral velocity components of tunnel turbulence were obtained in the Langley Transonic Dynamics Tunnel test section using a constant-temperature anemometer equipped with a hot-film X-probe. For these tests air was the test medium. Test conditions included tunnel velocities ranging from 100 to 500 fps at atmospheric pressure. Standard deviations of turbulence velocities were determined and power spectra were computed. Unconstrained optimization was employed to determine parameter values of a general spectral model of a form similar to that used to describe atmospheric turbulence. These parameters, and others (notably break frequency and integral scale length), were determined at each test condition and compared with those of Dryden and Von Karman atmospheric turbulence spectra. When the data were discovered to be aliased, the spectral model was modified to account for and 'eliminate' the aliasing. Author (revised)

N93-22797# MiTech, Inc., Pleasantville, NJ.

SOFT-GROUND ARRESTING SYSTEM FOR COMMERCIAL AIRCRAFT Interim Report

Robert Cook Feb. 1993 39 p

(DOT/FAA/CT-TN93/4) Avail: CASI HC A03/MF A01

A soft-ground arresting system provides an economical and nondestructive means for decelerating an aircraft that would otherwise be unable to stop safely within the confines of the runway including the safety or overrun area. This report validates a mathematical model developed to predict deceleration of an aircraft as it travels through a soft-ground arresting system. Full-scale tests were conducted at the Federal Aviation Administration Technical Center using the FAA's instrumented B-727 aircraft. The speed of the aircraft entering the beds ranged from 20 to 80 knots. The dimensions of the bed were as follows: foam thickness range was from 6 to 18 inches; test bed length was from 88 to 176 feet; width was always 40 feet. In each test the deceleration experienced by the aircraft was recorded in addition to its velocity, landing gear loads, and brake torque. The results of these tests showed that actual measured parameters from the aircraft were within 10 percent of the values predicted by the mathematical model; thus validating the accuracy of this model. The 18-inch-thick foam bed provided the most effective deceleration without exceeding the stresses encountered by the aircraft during normal operation. Fire and rescue equipment can maneuver and conduct emergency operations within the foam arrestor bed without difficulty. Author

N93-22874# Mitre Corp., McLean, VA. Center for Advanced Aviation System Development.

OPERATIONAL EVALUATION OF THE CONVERGING RUNWAY DISPLAY AID AT SAINT LOUIS Final Report

M. R. Gilligan and A. E. Gross Dec. 1992 165 p

(Contract DTFA01-89-C-00001)

(MTR-92W0000217; DOT/FAA/RD-93/7) Avail: CASI HC A08/MF A02

This report describes the evaluation of the Converging Runway Display Aid (CRDA) which has been used in an operational environment at Lambert-St. Louis International Airport since December 1990. The intent of the evaluation has been to determine the operational benefits of using CRDA at St. Louis and to assess the operational suitability of the aid for national implementation at those airports which have converging or intersecting runway configurations. As a result of the evaluation, the following was determined: the CRDA computer/human interface is operationally suitable; use of CRDA can increase airport capacity, and that with the DCIA procedures an acceptable margin of safety is provided. This report supports the decision to proceed with the national implementation of CRDA and provides guidance material for potential users of the aid. Author

N93-22987*# Lockheed Engineering and Sciences Co., Hampton, VA.

CONCEPT DEFINITION STUDY FOR AN EXTREMELY LARGE AEROPHYSICS RANGE FACILITY

Hallock F. Swift Washington Feb. 1993 171 p Prepared in cooperation with Physics Applications, Inc., Dayton, OH

(Contract NAS1-19000; RTOP 506-40-71-04)

(NASA-CR-4491; NAS 1.26:4491) Avail: CASI HC A08/MF A02

A conceptual design of a very large aeroballistic range is presented, as are its operational characteristics and procedures. The proposed model launcher is a two-stage light-gas gun, having a launch tube diameter of 254 mm, and the capability of accelerating a 14 kg launch mass to 6.1 km/sec. The gun's 91.4 cm diameter piston is driven by pressurized helium. High pressures in the central breech are contained by a multiple disk arrangement. The blast tank and sabot separation tank are described, as are methods for arresting sabot segments. The conceptual design of the range itself includes a 3.3 m diameter test or flight chamber some 330 m in length. Provisions are made for testing of free flight models and tests in which the model is confined by a track system. Methods for model deceleration and recovery are described. Provisions required for future addition of advanced model launchers such as an electromagnetic launcher or ram accelerator are addressed. Siting and safety issues are also addressed. Author

N93-23087# Heli-Air, Inc., Broussard, LA.

ICING CLOUD SIMULATOR FOR USE IN HELICOPTER ENGINE INDUCTION SYSTEM ICE PROTECTION TESTING

S. W. Brunnenkant Dec. 1992 53 p

(DOT/FAA/CT-TN92/43) Avail: CASI HC A04/MF A01

Aircraft with Airborne Icing Spraying Systems (AISS) have been used for some time to generate icing clouds into which test aircraft could be flown to show compliance with the requirements of FAR XX.1093. However, the spray arrays used and the relatively large distance between the AISS and aircraft parts to be tested precluded small droplet sizes at high liquid water content at most atmospheric conditions. Some of these shortcomings were overcome by mounting the AISS directly on the test aircraft. This proved to be a very efficient method to develop and certify individual aircraft components. This report describes the methodology and test procedure used with an AISS mounted on a test aircraft to show compliance with FAR 29.1093 for the newly developed inlet of the Bell 222/250-C30G helicopter conversion. Development and certification testing was accomplished in a 4-week period. Author

N93-23114# Department of National Defence, Ottawa (Ontario). Directorate of Strategic Analysis.

AN ASSESSMENT OF PERMAFROST CONDITIONS AT THREE DND AIRPORTS IN ARCTIC CANADA AS THEY PERTAIN TO FUTURE PLANNING AND OPERATIONS

C. M. Tucker and A. S. Judge (Geological Survey of Canada, Ottawa, Ontario.) Jul. 1991 48 p

(ORAE Proj. 44107)

(ORAE-R107; CTN-93-60665) Avail: CASI HC A03

Over a cycle of seasons, ground penetrating radar studies were carried out at Arctic airports in Inuvik, Rankin Inlet, and Alert, Northwest Territories. Two of the airports were slated for significant upgrading of runways, taxiways, and parking aprons, providing a good opportunity to investigate the extent of permafrost and its seasonal variation at three locations distributed over a wide geographic area. The study method involved specific and repeated traverses with a Pulse EKKO 3 ground penetrating radar unit. The survey was successful in locating massive ice bodies, in imaging several existing problem areas beneath runways, and mapping the seasonal depth of thaw in permafrost. The study results imply that future monitoring at the sites should be continued in light of suggested ground stability problems due to global warming. Author (CISTI)

N93-23128# Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.

GEOGRID REINFORCED BASE COURSES FOR FLEXIBLE PAVEMENTS FOR LIGHT AIRCRAFT: TEST SECTION CONSTRUCTION, BEHAVIOR UNDER TRAFFIC, LABORATORY TESTS, AND DESIGN CRITERIA Final Report

Steve L. Webster Dec. 1992 100 p

(Contract DTFA01-89-Z-02029)

(DOT/FAA/RD-92/25) Avail: CASI HC A05/MF A02

The results of a literature review investigating geogrid reinforced base courses for flexible pavements for light aircraft and the design of a geogrid test section for field testing the validity of potential geogrid reinforcement results have been previously reported. The construction of the field test section, the behavior of the test section under traffic testing using a 30,000 lb single tire load, the data collected, laboratory tests that were conducted on the various geogrid products used in the field test section, and development of design criteria for geogrid base reinforcement for flexible pavements for light aircraft are described. Test results verified the validity of geogrid reinforced base courses for flexible pavements for light aircraft. A geogrid reinforcement product equivalent to the SS-2 geogrid used in the field tests can reduce the total pavement design thickness. The geogrid performance is a function of depth of placement. The thickness reductions range from approximately 40 percent for unreinforced pavement thicknesses of 11 in. to 5 percent for 20-in.-thick pavements. The geogrid reinforcement performs best when placed between the base course and subgrade. The improvement mechanisms for geogrid reinforcement include grid interlock with aggregate base material, subgrade confinement, and to some extent a tensioned membrane effect. The geogrid property requirements for optimum performance are not totally known at this time. The performance of the various geogrid products tested ranged from no improvement up to a 40 percent reduction in total pavement thickness requirement. A relatively rigid sheet-type product (SS-2) performed the best. Author (revised)

N93-23137# Nevada Univ., Reno. Dept. of Civil Engineering.

TEST REQUIREMENTS FOR COAL-TAR MIXTURES ON AIRPORT PAVEMENTS Final Report, May 1991 - Oct. 1992

Peter E. Sebaaly, Venu Thirmarayappa, and Jon Epps Jan. 1993 46 p

(Contract DTFA01-91-P-07315)

(DOT/FAA/RD-92-27) Avail: CASI HC A03/MF A01

The research documented represents an effort to evaluate the test procedures for coal tar mixtures. The various coal tar test methods were evaluated under several levels of test variables. The freeze-thaw and scuff resistance tests were evaluated under three types of shingles and an aluminum substrate. The fuel resistance test was evaluated under three levels of sand loading and three levels of film thickness. In addition, all of the tests were evaluated under two levels of humidity. The analysis of the data indicates that the effect of the substrate is insignificant in all of the tests. The effect of humidity is significant on some tests, while the effects of sand loading and film thickness are highly significant on the results of the fuel resistance tests. Author (revised)

N93-23217# Aviation Simulations International, Inc., Huntington, NY.

MULTIPATH RUNWAY EXITS AND TAXIWAYS Final Report

Everett S. Joline Jan. 1993 108 p Prepared for MiTech, Inc., Atlantic City, NJ

(Contract DTFA03-90-C-00036)

(DOT/FAA/CT-92/19) Avail: CASI HC A06/MF A02

As the level of air traffic demand increases in the future, and as advances are made in air traffic control technology to accommodate this traffic, the congestion resulting from aircraft moving on the ground may well become the limiting factor in airport capacity. A family of multipath concepts, based on the use of parallel redundancy for the key components of the airfield system, has been proposed as a means of ameliorating these problems. With these concepts, the number of runway crossings, departure queues, runway exits, and taxiways to/from gates would be increased to the design practices of today. An airport simulation model is used in this study to demonstrate each of the proposed concepts, as applied to six existing U.S. airports, and to develop quantitative estimates of the benefits of reducing delay and increasing throughput. The results show that while significant improvements in performance can be obtained, the application of a particular concept to a particular airport depends heavily on the characteristics of that airport. The study also demonstrates how simulation can be used as an effective tool for evaluating airport improvement alternatives at a specific airport. Author

N93-23420*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PERFORMANCE AND TEST SECTION FLOW CHARACTERISTICS OF THE NATIONAL FULL-SCALE AERODYNAMICS COMPLEX 80- BY 120-FOOT WIND TUNNEL

Peter T. Zell Jan. 1993 66 p

(RTOP 505-50-28)

(NASA-TM-103920; A-92058; NAS 1.15:103920) Avail: CASI HC A04/MF A01

Results from the performance and test section flow calibration of the 80- by 120-Foot Wind Tunnel are presented. Measurements indicating the 80- by 120-ft test section flow quality were obtained throughout the tunnel operational envelope and for atmospheric wind speeds up to approximately 20 knots. Tunnel performance characteristics and a dynamic pressure system calibration were also documented during the process of mapping the test section flow field. Experimental results indicate that the test section flow quality is relatively insensitive to dynamic pressure and the level of atmospheric winds experienced during the calibration. The dynamic pressure variation in the test section is within +/-75 percent of the average. The axial turbulence intensity is less than 0.5 percent up to the maximum test section speed of 100 knots, and the vertical and lateral flow angle variations are within +/-5 deg and +/-7 deg, respectively. Atmospheric winds were found to affect the pressure distribution in the test section only at high ratios of wind speed to test section speed. Author (revised)

N93-23705# Texas A&M Univ., College Station.

A COMPUTER SIMULATION OF A HYPERBARIC CHAMBER ENVIRONMENT M.S. Thesis

Scott R. Lister Dec. 1992 119 p

(Contract N00123-89-G-0598)

(AD-A260137) Avail: CASI HC A06/MF A02

A hyperbaric chamber environment is simulated using a FORTRAN computer program. This program allows the user to input data files of varying chamber conditions and provides a detailed output which can be used for design or chamber operations. Specifically, this program determines life support, temperature and humidity control, and power requirements. After developing the theory and describing the program in detail, complete examples simulating a hyperbaric chamber at 2000 fsw, a submarine lockout chamber at 400 fsw, and a shallow underwater habitat at 56 fsw are demonstrated. GRA

N93-24493*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AN INTEGRATED ROTORCRAFT AVIONICS/CONTROLS ARCHITECTURE TO SUPPORT ADVANCED CONTROLS AND LOW-ALTITUDE GUIDANCE FLIGHT RESEARCH

Robert A. Jacobsen, Douglas H. Doane, Michelle M. Eshow (Army Aviation Systems Command, Saint Louis, MO.), Edwin W. Aiken, and William S. Hindson Oct. 1992 19 p Presented at the Digital Avionics Conference, Seattle, WA, 5-8 Oct. 1992 Prepared in cooperation with U.S. Army Aviation Systems Command, St. Louis, MO

(RTOP 505-59-36)

(NASA-TM-103983; A-93000; NAS 1.15:103983) Avail: CASI HC A03/MF A01

Salient design features of a new NASA/Army research rotorcraft--the Rotorcraft-Aircrew Systems Concepts Airborne Laboratory (RASCAL) are described. Using a UH-60A Black Hawk helicopter as a baseline vehicle, the RASCAL will be a flying laboratory capable of supporting the research requirements of major NASA and Army guidance, control, and display research programs. The paper describes the research facility requirements of these programs together with other critical constraints on the design of the research system. Research program schedules demand a phased development approach, wherein specific research capability milestones are met and flight research projects are flown throughout the complete development cycle of the RASCAL. This development approach is summarized, and selected features of the research system are described. The research system includes a real-time obstacle detection and avoidance system which will generate low-altitude guidance commands to the pilot on

a wide field-of-view, color helmet-mounted display and a full-authority, programmable, fault-tolerant/fail-safe, fly-by-wire flight control system.
Author

N93-24601* National Aeronautics and Space Administration. Pasadena Office, CA.
MOTION MEASUREMENT OF ACOUSTICALLY LEVITATED OBJECT Patent
John L. Watkins, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and Martin B. Barmatz, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 20 Apr. 1993 5 p Filed 25 Feb. 1991
(NASA-Case-NPO-18191-1-CU; US-Patent-5,203,209;
US-Patent-Appl-SN-660380; US-Patent-Class-73-505;
Int-Patent-Class-G01P-13/04) Avail: US Patent and Trademark Office

A system is described for determining motion of an object that is acoustically positioned in a standing wave field in a chamber. Sonic energy in the chamber is sensed, and variation in the amplitude of the sonic energy is detected, which is caused by linear motion, rotational motion, or drop shape oscillation of the object. Apparatus for detecting object motion can include a microphone coupled to the chamber and a low pass filter connected to the output of the microphone, which passes only frequencies below the frequency of sound produced by a transducer that maintains the acoustic standing wave field. Knowledge about object motion can be useful by itself, can be useful to determine surface tension, viscosity, and other information about the object, and can be useful to determine the pressure and other characteristics of the acoustic field.
Official Gazette of the U.S. Patent and Trademark Office

N93-24643 Tana-Jyra, Ky (Finland).
BOGIE-GRIPPING TRANSFER DEVICE Patent Application
Matti Sinkkonen, inventor (to Tana-Jyra) 5 Mar. 1992 17 p
(CA-Patent-Appl-SN-024586; Int-Patent-Class-B64F-1/10; CTN-93-60682)
Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

A transfer device for gripping bogie wheels is discussed. The device will be used to move an aircraft or other wheeled device on a base. The device includes a frame section on which friction rollers that grip the bogie wheel are supported. Motors are provided to rotate at least three friction rollers for each wheel, and pressure devices are provided to press the friction rollers against the wheel. The device includes a power device, transmission devices to provide the motors with power, and devices to place the friction rollers around the wheels and to remove them. The placing devices of the friction rollers are attached to horizontal slides placed on one or more frame beams, so that the friction rollers are able to settle in a position corresponding to the distance between the axles of the set of bogie wheels. The device is applicable to bogie wheels of different sizes and with different distances between the axles, and the distribution of loading over several friction rollers enables minimization of the force per roller directed to the wheel. Author (CISTI)

N93-24644 Tana-Jyra, Ky (Finland).
WHEELED TRANSFER DEVICE FOR MOVING AN AIRCRAFT Patent Application
Matti Sinkkonen, inventor (to Tana-Jyra) 5 Mar. 1992 10 p
(CA-Patent-Appl-SN-2-024584; Int-Patent-Class-B64F-1/10; CTN-93-60684)
Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

A transfer device that is equipped with support wheels to move an aircraft or other device equipped with double wheels over a base is discussed. The device includes at least one so-called self-wedging friction roller which grips the wheels of the device beneath the axle, and two support wheels which drive at essentially the same peripheral velocity in the opposite direction. In the transfer device, these two driving support wheels are located close to the line of the friction roller. The transfer device of the invention includes a pushing section with its own wheels, power source, drive, and steering devices. The friction rollers and driving support wheels are located in a transfer unit connected to the pushing section by means of a boom. The boom is connected to the transfer unit by means of a vertical joint and to the pushing unit by means of a horizontal joint. Author (CISTI)

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N93-22204*# National Aeronautics and Space Administration, Washington, DC.
TEN-YEAR SPACE LAUNCH TECHNOLOGY PLAN
12 Nov. 1992 58 p Prepared in cooperation with Department of Defense, Washington, and Department of Energy, Washington Original contains color illustrations
(NASA-TM-108701; NAS 1.15:108701) Avail: CASI HC A04/MF A01; 1 functional color page

This document is the response to the National Space Policy Directive-4 (NSPD-4), signed by the President on 10 Jul. 1991. Directive NSPD-4 calls upon the Department of Defense (DoD), the Department of Energy (DOE), and the National Aeronautics and Space Administration (NASA) to coordinate national space launch technology efforts and to jointly prepare a 10-year space launch technology plan. The nation's future in space rests on the strength of its national launch technology program. This plan documents our current launch technology efforts, plans for future initiatives in this arena, and the overarching philosophy that links these activities into an integrated national technology program. Author (revised)

N93-22226*# National Aeronautics and Space Administration, Washington, DC.
NASA AUTOMATED RENDEZVOUS AND CAPTURE REVIEW. A COMPILATION OF THE ABSTRACTS Abstracts Only
1991 224 p Review held in Williamsburg, VA, 19-21 Nov. 1991 Prepared in cooperation with Spectra Research Systems, Inc., Arlington, VA
(Contract NASw-4341)
(NASA-TM-108598; NAS 1.15:108598) Avail: CASI HC A10/MF A03

This document presents a compilation of abstracts of papers solicited for presentation at the NASA Automated Rendezvous and Capture Review held in Williamsburg, VA on November 19-21, 1991. Due to limitations on time and other considerations, not all abstracts could be presented during the review. The organizing committee determined however, that all abstracts merited availability to all participants and represented data and information reflecting state-of-the-art of this technology which should be captured in one document for future use and reference. The organizing committee appreciates the interest shown in the review and the response by the authors in submitting these abstracts. For individual titles, see N93-22227 through N93-22321.

N93-22227*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEMONSTRATION OF AUTOMATED PROXIMITY AND DOCKING TECHNOLOGY Abstract Only **c13**
Robert L. Anderson (TRW, Inc., Redondo Beach, CA.), Roy K. Tsugawa (TRW, Inc., Redondo Beach, CA.), and Thomas C. Bryan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Automated spacecraft docking operations are being performed using a full scale motion based simulator and an optical sensor. This presentation will discuss the work in progress at TRW and MSFC facilities to study the problem of automated proximity and docking operations. The docking sensor used in the MSFC Optical Sensor and simulation runs are performed using the MSFC Flat Floor Facility. The control algorithms and six degrees of freedom (6DOF) simulation software were developed at TRW and integrated into the MSFC facility. Key issues being studied are the quantification of docking sensor requirements and operational constraints necessary to perform automated docking maneuvers, control algorithms capable of performing automated docking in the presence of sensitive and noisy sensor data, and sensor technologies for automated proximity and docking operations. As part of this study the MSFC sensor characteristics were analyzed and modeled so that off line simulation runs can be performed for control algorithm testing. Our goal is to develop and demonstrate full 6DOF docking capabilities with actual sensors on the MSFC motion based simulator. We present findings from actual docking simulation runs which show sensor and control loop performance as well as problem areas

which require close attention. The evolution of various control algorithms using both phase plane and Clohessy-Wiltshire techniques are discussed. In addition, 6DOF target acquisition and control strategies are described.
Author

N93-22228*# Sverdrup Technology, Inc., Huntsville, AL.
CARGO TRANSFER VEHICLE RCS PROPELLANT CONTAMINATION ISSUES Abstract Only **c28**
Richard O. Ballard *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The purpose of this report is to address Cargo Transfer Vehicle (CTV) RCS contamination issues and contribute to the resources necessary to optimize the vehicle and propulsion systems required in the CTV of the National Launch System (NLS) Heavy Lift Launch Vehicle (HLLV). This study reviews the thruster-induced contaminants; their transportation from the thrust chamber to the vehicle, payload, and SSF; and the mechanism by which damage is inflicted on their components. The effect of both monopropellant and bipropellant RCS rocket exhaust plumes on a spacecraft and related functional surfaces has been the subject of considerable study over the years. It is recognized that the RCS rocket produces contaminants which can significantly degrade the performance of optical windows, solar cells, thermal-protective coatings, and other external vehicle components. This is particularly true when the rocket is operating in the pulse mode. The exhaust plume impingement pressure and heat-transfer phenomena also complicate the environment to which the vehicle and its functional surfaces are exposed, but are not addressed in this study. Bipropellant contamination presented several modes of damage to incident surfaces, which can pose a long-term deleterious consequence to CTV payloads and the Space Station Freedom (SSF). Monopropellant contamination did not pose any significant long-term issues other than the possibility of aniline deposition. The use of either bipropellant and monopropellant propulsion systems can have a design impact on the CTV propulsion system with respect to maneuvering operations in the proximity of SSF.
Author

N93-22229*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HYBRID NEURAL NETWORK AND FUZZY LOGIC APPROACHES FOR RENDEZVOUS AND CAPTURE IN SPACE Abstract Only **c63**
Hamid R. Berenji and Timothy Castellano *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The nonlinear behavior of many practical systems and unavailability of quantitative data regarding the input-output relations makes the analytical modeling of these systems very difficult. On the other hand, approximate reasoning-based controllers which do not require analytical models have demonstrated a number of successful applications such as the subway system in the city of Sendai. These applications have mainly concentrated on emulating the performance of a skilled human operator in the form of linguistic rules. However, the process of learning and tuning the control rules to achieve the desired performance remains a difficult task. Fuzzy Logic Control is based on fuzzy set theory. A fuzzy set is an extension of a crisp set. Crisp sets only allow full membership or no membership at all, whereas fuzzy sets allow partial membership. In other words, an element may partially belong to a set.
Author

N93-22230*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
AN AUTOMATED SYSTEM FOR SPACECRAFT PROXIMITY OPERATIONS Abstract Only **c18**
E. Bergmann *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

With the advent of multiple-vehicle operations in support of the space station, on-orbit refurbishment, and several other missions, there is a need to intelligently plan proximity operations trajectories that will conserve limited available fuel while avoiding collisions. Upon reaching the objective, the capture process entails several unique considerations, such as coordinating motion with a tumbling target, the capture itself, and adapting to control of the new configuration resulting from the capture operation. This paper outlines a systematic process of technical development over several years at the Draper laboratory, culminating in a capability to perform manual augmented or fully autonomous rendezvous, capture, and control of the resulting configuration.
Author

N93-22231*# Lockheed Engineering and Sciences Co., Houston, TX.
SIX-DEGREE-OF-FREEDOM TEST FACILITY Abstract Only **c14**
Michelle A. Bittel *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Shuttle to Space station docking has become an important issue in the last few years. Docking sensors have been proposed that will provide high precision measurements required for the fuel efficient rendezvous and docking of space vehicles. These sensors will also be used for satellite servicing and orbital assembly. The performance of the docking sensors must be tested before they are implemented in a space environment. A Six-Degree-of-Freedom (6-DOF) Test Facility has been developed at the Tracking & Communications Section, Johnson Space Center to test the static and dynamic accuracies of docking sensors. A candidate sensor is evaluated by comparing the sensor's static position and velocity measurements to the more accurate 6-DOF system. The 6-DOF Test Facility's hardware is fully integrated. Software has been developed in-house to support system operation. The system has been tested statically and the operational parameters verified. System accuracies remain to be determined. Dynamic testing of the facility is expected to begin shortly. Several companies such as McDonnell Douglas, Autonomous Technologies, and General Dynamics are scheduled to test sensors in the next few months. The 6-DOF facility will be available for use in November 1991. This presentation describes the subcomponents, operation, and capabilities of the 6-DOF Test Facility. Discussions will be held on system accuracies. Additional applications of the 6-DOF system will also be addressed.
Author

N93-22232*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A STRONGLY GOAL-DIRECTED CLOSE-RANGE VISION SYSTEM FOR SPACECRAFT DOCKING Abstract Only **c74**
Kim L. Boyer (Ohio State Univ., Columbus.) and Ralph E. Goddard *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

In this presentation, we will propose a strongly goal-oriented stereo vision system to establish proper docking approach motions for automated rendezvous and capture (AR&C). From an input sequence of stereo video image pairs, the system produces a current best estimate of: contact position; contact vector; contact velocity; and contact orientation. The processing demands imposed by this particular problem and its environment dictate a special case solution; such a system should necessarily be, in some sense, minimalist. By this we mean the system should construct a scene description just sufficiently rich to solve the problem at hand and should do no more processing than is absolutely necessary. In addition, the imaging resolution should be just sufficient. Extracting additional information and constructing higher level scene representations wastes energy and computational resources and injects an unnecessary degree of complexity, increasing the likelihood of malfunction. We therefore take a departure from most prior stereopsis work, including our own, and propose a system based on associative memory. The purpose of the memory is to immediately associate a set of motor commands with a set of input visual patterns in the two cameras. That is, rather than explicitly computing point correspondences and object positions in world coordinates and trying to reason forward from this information to a plan of action, we are trying to capture the essence of reflex behavior through the action of associative memory. The explicit construction of point correspondences and 3D scene descriptions, followed by online velocity and point of impact calculations, is prohibitively expensive from a computational point of view for the problem at hand. Learned patterns on the four image planes, left and right at two discrete but closely spaced instants in time, will be bused directly to infer the spacecraft reaction. This will be a continuing online process as the docking collar approaches.
Author

N93-22233*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

MANNED MANEUVERING UNIT APPLICATIONS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only **c18**

Donald L. Brehm (Martin Marietta Corp., Denver, CO.), John A. Cuseo (Martin Marietta Corp., Denver, CO.), Joseph A. Lenda (Martin Marietta Corp., Denver, CO.), Lex Ray (Martin Marietta Corp., Denver, CO.), and C. Edward Whitsett *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Automated Rendezvous and Capture (AR&C) is an important technology to multiple National Aeronautics and Space Administration (NASA) programs and centers. The recent Johnson Spacecraft Center (JSC) AR&C Quality Function Deployment (QFD) has listed on-orbit demonstration of related technologies as a near term priority. Martin Marietta has been evaluating use of the Manned Maneuvering Unit (MMU) for a low cost near term on-orbit demonstration of AR&C technologies such as control algorithms, sensors, and processors as well as system level performance. The MMU Program began in 1979 as the method of repairing the Space Shuttle (STS) Thermal Protection System (the tiles). The units were not needed for this task, but were successfully employed during three Shuttle flights in 1984: a test flight was flown in in February as proof of concept, in April the MMU participated in the Solar Max Repair Mission, and in November the MMU's returned to space to successfully rescue the two errant satellites, Westar and Palapa. In the intervening years, the MMU simulator and MMU Qualification Test Unit (QTU) have been used for Astronaut training and experimental evaluations. The Extra-Vehicular Activities (EVA) Retriever has used the QTU, in an unmanned form, as a free-flyer on the Johnson Space Center (JSC) Precision Air Bearing Floor (PABF). Currently, the MMU is undergoing recertification for flight. The two flight units were removed from storage in September, 1991 and evaluation tests were performed. The tests demonstrated that the units are in good shape with no discrepancies that would preclude further use. The Return to Flight effort is currently clearing up recertification issues and evaluating the design against the present Shuttle environments. Author

N93-22234*# Sterling Software, Moffett Field, CA.

MANNED VERSUS UNMANNED RENDEZVOUS AND CAPTURE Abstract Only **c13**

Adam R. Brody *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Rendezvous and capture (docking) operations may be performed either automatically or under manual control. In cases where humans are far from the mission site, or high-bandwidth communications lines are not in place, automation is the only option. Such might be the case with unmanned missions to the moon or Mars that involve orbital docking or cargo transfer. In crewed situations where sensors, computation capabilities, and other necessary instrumentation are unavailable, manual control is the only alternative. Power, mass, cost, or other restrictions may limit the availability of the machinery required for an automated rendezvous and capture. The only occasions for which there is a choice about whether to use automated or manual control are those where the vehicle(s) have both the crew and instrumentation necessary to perform the mission either way. The following discussion will focus on the final approach or capture (docking) maneuver. The maneuvers required for long-range rendezvous operations are calculated by computers. It is almost irrelevant whether it is an astronaut, watching a count-down timer who pushes the button firing the thruster or whether the computer keeps track of the time and fires with the astronaut monitoring. The actual manual workload associated with a mission that may take as long as hours or days to perform is small. The workload per unit time increases tremendously during the final approach (docking) phase and this is where the issue of manual versus automatic is more important. Author

N93-22235*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

AUTONOMOUS RENDEZVOUS AND CAPTURE DEVELOPMENT INFRASTRUCTURE Abstract Only **c13**

Thomas C. Bryan, Fred Roe, Cindy Coker, Pam Nelson, and B. Johnson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

In the development of the technology for autonomous rendezvous and docking, key infrastructure capabilities must be used for effective and economical development. This involves facility capabilities, both equipment and personnel, to devise, develop, qualify, and integrate ARD elements and subsystems into flight programs. One effective way of reducing technical risks in developing ARD technology is the use of the ultimate test facility, using a Shuttle-based reusable free-flying testbed to perform a Technology Demonstration Test Flight which can be structured to include a variety of additional sensors, control schemes, and operational approaches. This conceptual testbed and flight demonstration will be used to illustrate how technologies and facilities at MSFC can be used to develop and prove an ARD system. Author

N93-22236*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

NATIONAL LAUNCH SYSTEM OVERVIEW WITH FOCUS ON CARGO TRANSFER VEHICLE Abstract Only **c15**

Harry Buchanan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

As a result of the Augustine Committee's recommendation to the National Space Council, NASA, and the DOD have embarked on a joint program to provide the nation with a new capability for transporting payloads into space. The National Launch System (NLS) consists of a family of modular launch vehicles, combining elements of current launchers (Titan and Shuttle) with newly developed components. This family consists of (1) NLS-1 (a vehicle capable of delivering 80 k to SSF), (2) NLS-2 (a vehicle capable of delivering 50k to LEO), and (3) NLS-3 (a vehicle capable of delivering 20 k to LEO). Management of the program is shared between the two agencies with a Joint Program Office carrying out the level 2 management and integration function while both the NASA and Air Force field organizations are charged with the various development and operational responsibilities. Author

N93-22237*# Idaho National Engineering Lab., Idaho Falls.

AUTOMATED TECHNOLOGIES NEEDED TO PREVENT RADIOACTIVE MATERIALS FROM REENTERING THE ATMOSPHERE Abstract Only

David Buden and Joseph A. Angelo, Jr. (Science Applications International Corp., Melbourne, FL.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 6 p (For primary document see N93-22226 08-12)

Avail: CASI HC A02/MF A03

Project SIREN (Search, Intercept, Retrieve, Expulsion Nuclear) has been created to identify and evaluate the technologies and operational strategies needed to rendezvous with and capture aerospace radioactive materials (e.g., a distressed or spent space reactor core) before such materials can reenter the terrestrial atmosphere and then to safely move these captured materials to an acceptable space destination for proper disposal. A major component of the current Project SIREN effort is the development of an interactive technology model (including a computerized data base) that explores in building block fashion the interaction of the technologies and procedures needed to successfully accomplish a SIREN mission. This SIREN model will include appropriate national and international technology elements-both contemporary and projected into the next century. To permit maximum flexibility and use, the SIREN technology data base is being programmed for use on 386-class PC's. Author

N93-22238*# Lockheed Engineering and Sciences Co., Houston, TX.

AUTONOMOUS PREALIGNMENT OF A DOCKING MECHANISM Abstract Only **c18**

Monty B. Carroll and John A. Thompson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Proposed future space exploration, such as lunar and Martian expeditions, will require autonomous docking of space vehicles. One proposed candidate method of autonomous docking utilizes a actively controlled parallel manipulator. Operation of the proposed docking manipulator can be

segmented into four successive events: prealignment, capture/latching, attenuation, and structural rigidization. This paper discusses the development and testing of a digitally controlled, six-degree-of-freedom (6-DOF), parallel manipulator for the prealignment segment of a docking spacecraft. Author

N93-22239*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

US AUTOMATED RENDEZVOUS AND CAPTURE CAPABILITIES REVIEW. REMOTE UMBILICAL SYSTEM ABSTRACT Abstract Only **c13**

Eduardo Lopez delCastillo *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

This document will describe the technology developed at Kennedy Space Center (KSC) to demonstrate automatic tracking, docking, and mating of umbilical systems. Specifically the use of a real time six degree of freedom (6DOF) target tracking vision system, (developed by Adaptive Automation, Inc. under contract to KSC), is discussed in detail. The paper describes the use of mechanical compliance in the docking, mating, and tracking-after-mating operations. The vision system computes six coordinates that define the position and orientation of a three dimensional target using data from a single CCD camera. The camera is mounted on a 6DOF robot arm. After target coordinates are computed, they are transmitted to a supervisory computer which controls the robot motion in real time. Details of the image processing algorithms, image processing hardware, and target configuration used in the vision system are discussed in the paper. The motion of the space vehicle relative to the service structure after mating led us to the development of a compliant system that allows enough displacement of the target relative to the camera so that tracking after mating may continue. This reduces internal stresses between flight and ground hardware. Author

N93-22240*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AUTOMATED TARGET RECOGNITION AND TRACKING USING AN OPTICAL PATTERN RECOGNITION NEURAL NETWORK Abstract Only **c74**

Tien-Hsin Chao *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The on-going development of an automatic target recognition and tracking system at the Jet Propulsion Laboratory is presented. This system is an optical pattern recognition neural network (OPRNN) that is an integration of an innovative optical parallel processor and a feature extraction based neural net training algorithm. The parallel optical processor provides high speed and vast parallelism as well as full shift invariance. The neural network algorithm enables simultaneous discrimination of multiple noisy targets in spite of their scales, rotations, perspectives, and various deformations. This fully developed OPRNN system can be effectively utilized for the automated spacecraft recognition and tracking that will lead to success in the Automated Rendezvous and Capture (AR&C) of the unmanned Cargo Transfer Vehicle (CTV). One of the most powerful optical parallel processors for automatic target recognition is the multichannel correlator. With the inherent advantages of parallel processing capability and shift invariance, multiple objects can be simultaneously recognized and tracked using this multichannel correlator. This target tracking capability can be greatly enhanced by utilizing a powerful feature extraction based neural network training algorithm such as the neocognitron. The OPRNN, currently under investigation at JPL, is constructed with an optical multichannel correlator where holographic filters have been prepared using the neocognitron training algorithm. The computation speed of the neocognitron-type OPRNN is up to 10(exp 14) analog connections/sec that enabling the OPRNN to outperform its state-of-the-art electronics counterpart by at least two orders of magnitude. Author

N93-22241*# Lockheed Engineering and Sciences Co., Houston, TX.

APPLICABILITY OF RELATIVE GPS TO AUTOMATED RENDEZVOUS BETWEEN THE SPACE SHUTTLE AND SPACE STATION Abstract Only **c17**

Fred D. Clark and Ann Christofferson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The purpose of this study is to determine the adequacy of the Global Positioning System (GPS) in providing relative navigation for automated rendezvous and proximity operations. The study was performed using the Proximity Operations Simulator (POS), Lockheed's high-fidelity, 6 degree of freedom simulation of the space shuttle and space station. This simulation includes identical models of GPS receivers for each vehicle. The navigation software in each vehicle includes identical Kalman filters. Each filter computes the absolute state of its vehicle, and the relative state vector is obtained by simply subtracting absolute states. Author

N93-22242*# National Aeronautics and Space Administration, Washington, DC.

AUTONOMOUS RENDEZVOUS AND DOCKING: A COMMERCIAL APPROACH TO ON-ORBIT TECHNOLOGY VALIDATION Abstract Only **c13**

Peter Tchoryk, Jr. (Environmental Research Inst. of Michigan, Ann Arbor.), Michael E. Dobbs (Environmental Research Inst. of Michigan, Ann Arbor.), David J. Conrad (Environmental Research Inst. of Michigan, Ann Arbor.), Dale J. Apley (Environmental Research Inst. of Michigan, Ann Arbor.), and Raymond P. Whitten *In its* NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The Space Automation and Robotics Center (SpARC), a NASA-sponsored Center for the Commercial Development of Space (CCDS), in conjunction with its corporate affiliates, is planning an on-orbit validation of autonomous rendezvous and docking (ARD) technology. The emphasis in this program is to utilize existing technology and commercially available components whenever possible. The primary subsystems that will be validated by this demonstration include GPS receivers for navigation, a video-based sensor for proximity operations, a fluid connector mechanism to demonstrate fluid resupply capability, and a compliant, single-point docking mechanism. The focus for this initial experiment will be expendable launch vehicle (ELV) based and will make use of two residual Commercial Experiment Transporter (COMET) service modules. The first COMET spacecraft will be launched in late 1992 and will serve as the target vehicle. The ARD demonstration will take place in late 1994, after the second COMET spacecraft has been launched. The service module from the second COMET will serve as the chase vehicle. Author

N93-22243*# Martin Marietta Corp., Denver, CO. Space Operations Simulation Lab.

REAL-TIME SIMULATIONS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only **c13**

John A. Cuseo *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Although the individual technologies for automated rendezvous and capture (AR&C) exist, they have not yet been integrated to produce a working system in the United States. Thus, real-time integrated systems simulations are critical to the development and pre-flight demonstration of an AR&C capability. Real-time simulations require a level of development more typical of a flight system compared to purely analytical methods, thus providing confidence in derived design concepts. This presentation will describe Martin Marietta's Space Operations Simulation (SOS) Laboratory, a state-of-the-art real-time simulation facility for AR&C, along with an implementation for the Satellite Servicer System (SSS) Program. Author

N93-22244*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

AUTONOMOUS RENDEZVOUS AND CAPTURE SYSTEM DESIGN Abstract Only **c18**

Richard W. Dabney *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Marshall Space Flight Center has a long history of involvement in the

design of Autonomous Rendezvous and Capture (AR&C) systems. The first extensive studies were begun in the late seventies, incrementally leading to the development of an assortment of Guidance, Navigation, and Control (GN&C) concepts and algorithms suitable for a variety of mission requirements and spacecraft capabilities, with a strong emphasis placed upon flexible system-level design. These efforts have led to the development of sophisticated algorithms for docking with tumbling targets, and simple but efficient algorithms for stabilized spacecraft; each has been tested and validated using dynamic system simulation, with hardware in the loop when practical. Recent investigations include the use of neural networks for video image interpretation, and fuzzy logic for control system implementation. Author

N93-22245*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

IMP: A PERFORMANCE CODE Abstract Only c13

Vincent A. Dauro, Sr. *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

IMP (Integrated Mission Program) is a simulation language and code used to model present and future Earth, Moon, or Mars missions. The profile is user controlled through selection from a large menu of events and maneuvers. A Fehlberg 7/13 Runge-Kutta integrator with error and step size control is used to numerically integrate the differential equations of motion (DEQ) of three spacecraft, a main, a target, and an observer. Through selection, the DEQ's include guided thrust, oblate gravity, atmosphere drag, solar pressure, and Moon gravity effects. Guide parameters for thrust events and performance parameters of velocity changes (Delta-V) and propellant usage (maximum of five systems) are developed as needed. Print, plot, summary, and debug files are output. Author

N93-22246*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

CONTROL OF A VARYING THRUST SPACECRAFT FOR AUTONOMOUS SPACE RENDEZVOUS Abstract Only c18

Travis E. Dawson, Jr. *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Before the use of autonomous rendezvous will be allowed as a substitute for man-in-the-loop control, adequate safety and mission performance will have to be guaranteed. Most autopilots for autonomous rendezvous of spacecraft assume constant thrust reaction control system (RCS) thrusters. This assumption implies either true constant thrust RCS thrusters or thrusters whose thrust levels vary very slowly. The ongoing work described in this presentation examines the autonomous rendezvous problem when varying thrust RCS thrusters are inherent in the system equations of motion. Author

N93-22247*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

LASER DOCKING SENSOR ENGINEERING MODEL Abstract Only c36

Kent Dekome and Joseph M. Barr (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

NASA JSC has been involved in the development of Laser sensors for the past ten years in order to support future rendezvous and docking missions, both manned and unmanned. Although many candidate technologies have been breadboarded and evaluated, no sensor hardware designed specifically for rendezvous and docking applications has been demonstrated on-orbit. It has become apparent that representative sensors need to be flown and demonstrated as soon as possible, with minimal cost, to provide the capability of the technology in meeting NASA's future AR&C applications. Technology and commercial component reliability have progressed to where it is now feasible to fly hardware as a detailed test objective minimizing the overall cost and development time. This presentation will discuss the ongoing effort to convert an existing in-house developed breadboard to an engineering model configuration suitable for flight. The modifications include improving the ranger resolution and stability with an in-house design, replacing the rack mounted galvanometric scanner drivers with STD-bus cards, replacing the system controlling personal computer with a microcontroller, and repackaging the subsystems as appropriate. The sensor will use the performance parameters defined in previous JSC requirements working groups as design goals and be built to withstand the space environment where fiscally feasible. Testing of the in-house ranger design is expected to be completed in October. The results will be included in the presentation. Preliminary testing of the ranging circuitry indicates a range resolution of 4mm is possible. The sensor will be mounted in the payload bay on a shelf bracket and have command, control, and display capabilities using the payload general support computer via an RS422 data line. Author

N93-22248*# Rockwell International Corp., Anaheim, CA. Autonetics Strategic Systems Div.

RENDEZVOUS STRATEGY IMPACTS ON CTV AVIONICS DESIGN, SYSTEM RELIABILITY REQUIREMENTS, AND AVAILABLE COLLISION AVOIDANCE MANEUVERS Abstract Only c18

William J. Donovan and John E. Davis *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Rockwell International is conducting an ongoing program to develop avionics architectures that provide high intrinsic value while meeting all mission objectives. Studies are being conducted to determine alternative configurations that have low life-cycle cost and minimum development risk, and that minimize launch delays while providing the reliability level to assure a successful mission. This effort is based on four decades of providing ballistic missile avionics to the United States Air Force and has focused on the requirements of the NASA Cargo Transfer Vehicle (CTV) program in 1991. During the development of architectural concepts it became apparent that rendezvous strategy issues have an impact on the architecture of the avionics system. This is in addition to the expected impact on propulsion and electrical power duration, flight profiles, and trajectory during approach. Author

N93-22249*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THE REAL-TIME OPERATIONS OF THE SPACE SHUTTLE ORBITER DURING RENDEZVOUS AND PROXIMITY OPERATIONS Abstract Only c16

Andrew Dougherty and Chris Meyer (Rockwell Space Operations Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

The Space Shuttle Orbiter is the only U.S. spacecraft in operation today that routinely performs an orbital rendezvous with another spacecraft. The trajectory planning and training of both flight crews and ground operations personnel required to achieve a 100 percent success rate is considerable. The preflight planning and training can be reduced through very simple design considerations of a new space vehicle. Author

N93-22250*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

COHERENT DOPPLER LIDAR FOR AUTOMATED SPACE VEHICLE, RENDEZVOUS, STATION-KEEPING AND CAPTURE Abstract Only c36

James A. Dunkin *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Recent advances in eye-safe, short wavelength solid-state lasers offer real potential for the development of compact, reliable, light-weight, efficient coherent lidar. Laser diode pumping of these devices has been demonstrated, thereby eliminating the need for flash lamp pumping, which has been a major drawback to the use of these lasers in space based applications. Also these lasers now have the frequency stability required to make them useful in coherent lidar, which offers all of the advantages of non-coherent lidar, but with the additional advantage that direct determination of target velocity is possible by measurement of the Doppler shift. By combining the Doppler velocity measurement capability with the inherent high angular resolution and range accuracy of lidar it is possible to construct

Doppler images of targets for target motion assessment. A coherent lidar based on a Tm,Ho:YAG 2-micrometer wavelength laser was constructed and successfully field tested on atmospheric targets in 1990. This lidar incorporated an all solid state (laser diode pumped) master oscillator, in conjunction with a flash lamp pumped slave oscillator. Solid-state laser technology is rapidly advancing, and with the advent of high efficiency, high power, semiconductor laser diodes as pump sources, all-solid-state, coherent lidars are a real possibility in the near future. MSFC currently has a feasibility demonstration effort under way which will involve component testing, and preliminary design of an all-solid-state, coherent lidar for automatic rendezvous, and capture. This two year effort, funded by the Director's Discretionary Fund is due for completion in 1992. Author

N93-22251*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A SYNTHETIC ENVIRONMENT FOR VISUALIZATION AND PLANNING OF ORBITAL MANEUVERS Abstract Only **c14**

Stephen R. Ellis (California Univ., Berkeley.) and Arthur J. Grunwald (Technion - Israel Inst. of Tech., Haifa.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

An interactive proximity operations planning system, which allows on-site planning of fuel-efficient, multi-burn maneuvers in a potential multi-space-craft environment has been developed and tested. This display system most directly assists planning by providing visual feedback in a synthetic virtual space that aids visualization of trajectories and their constraints. Its most significant features include (1) an 'inverse dynamics' algorithm that removes control nonlinearities facing the operator and (2) a stack-oriented action-editor that reduces the order of control and creates, through a 'geometric spreadsheet,' the illusion of an inertially stable environment. This synthetic environment provides the user with control of relevant static and dynamic properties of way-points during small orbital changes allowing independent solutions to otherwise coupled problems of orbital maneuvering. Author

N93-22252*# General Dynamics Corp., San Diego, CA. Space Systems Div.

AUTONOMOUS RENDEZVOUS AND DOCKING OPERATIONS OF UNMANNED EXPENDABLE CARGO TRANSFER VEHICLES (E.G. CENTAUR) WITH SPACE STATION FREEDOM Abstract Only **c13**

Brian R. Emmet *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

This paper describes the results of the feasibility study using Centaur or other CTV's to deliver payloads to the Space Station Freedom (SSF). During this study was examined the requirements upon unmanned cargo transfer stages (including Centaur) for phasing, rendezvous, proximity operations and docking/berthing (capture). Author

N93-22253*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

TRAC BASED SENSING FOR AUTONOMOUS RENDEZVOUS Abstract Only **c13**

Louis J. Everett (Texas A&M Univ., College Station.) and Leo Monford *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

This paper describes a TRAC (Targeting Reflective Alignment Concept) based sensing system for use in an autonomous rendezvous and docking experiment. The proposed experiment will utilize a COMET (COMmercial Experiment Transporter) based target satellite and a second chase vehicle. The sensor system consists of a target mounted on the target vehicle and a vision based sensor on the chase vehicle. The target has both active and passive components to enable the evaluation of both technologies. The chase vehicle will possess structured lighting and a single off the shelf camera. Author

N93-22254*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

FLIGHT SUPPORT SYSTEM (FSS) DOCKING AND UMBILICAL SERVICES SYSTEMS Abstract Only **c18**

Edward Falkenhayn *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

The Satellite Servicing Project at GSFC in the early 80's developed a facility for servicing observatories in orbit when docked on the shuttle. The facility includes a three point docking ring and one or two umbilicals to provide power, data and command capability to docked payloads. This facility was used in the 1984 repair of the Solar Maximum satellite. It will be used for the Hubble repair mission in 1993, and it is planned to be used on the Explorer Platform retrieval mission in 1995 and for servicing AXAF in the late 90's. The basic three point docking mechanisms and umbilical interfaces were adopted by the OMU Project for that vehicle's remote rendezvous and docking mission capability. This would have assured a common interface for a serviceable payload for either shuttle based or remote servicing, i.e., HST. For OMU remote servicing, quick reaction docking latches were under development when that Project was cancelled. Although there is no remote servicing capability being funded at present, the EOS spacecraft configuration does include three pins compatible with the FSS latches as a contingency planning measure. Author

N93-22255*# TRW, Inc., Redondo Beach, CA. Engineering and Test Div.

ON-BOARD FAULT MANAGEMENT FOR AUTONOMOUS SPACECRAFT Abstract Only **c18**

Lorraine M. Fesq, Amy Stephan, Susan C. Doyle, Eric Martin, and Suzanne Sellers *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

The dynamic nature of the Cargo Transfer Vehicle's (CTV) mission and the high level of autonomy required mandate a complete fault management system capable of operating under uncertain conditions. Such a fault management system must take into account the current mission phase and the environment (including the target vehicle), as well as the CTV's state of health. This level of capability is beyond the scope of current on-board fault management systems. This presentation will discuss work in progress at TRW to apply artificial intelligence to the problem of on-board fault management. The goal of this work is to develop fault management systems. This presentation will discuss work in progress at TRW to apply artificial intelligence to the problem of on-board fault management. The goal of this work is to develop fault management systems that can meet the needs of spacecraft that have long-range autonomy requirements. We have implemented a model-based approach to fault detection and isolation that does not require explicit characterization of failures prior to launch. It is thus able to detect failures that were not considered in the failure and effects analysis. We have applied this technique to several different subsystems and tested our approach against both simulations and an electrical power system hardware testbed. We present findings from simulation and hardware tests which demonstrate the ability of our model-based system to detect and isolate failures, and describe our work in porting the Ada version of this system to a flight-qualified processor. We also discuss current research aimed at expanding our system to monitor the entire spacecraft. Author

N93-22256*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

IMAGE BASED TRACKING APPROACHES TO AR/C AT THE JOHNSON SPACE CENTER Abstract Only **c19**

Timothy E. Fisher and Alan T. Smith (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Automated Rendezvous and Capture (AR&C) requires the determination of the six degrees of freedom relating two free bodies. Sensor systems that can provide such information have varying sizes, weights, power requirements, complexities and accuracies. One type of sensor system

which can provide several key advantages is an image based tracking system, or better known as a machine vision system. By image based tracking we mean that the sensor is some imaging device such as one or more video cameras, from which the tracking parameters necessary to support the rendezvous and capture operations (range, attitude, etc.) can be derived. Image based tracking offers many advantages such as relative hardware simplicity and reprogrammability. These advantages must be weighed against the disadvantages of these systems, such as limited operational range, poorer accuracy at greater distances and sensitivity to lighting conditions. However, with properly designed algorithms and targets these disadvantages can be minimized for many important applications. Rigorous testing in realistic environments can further increase the robustness and reliability of these systems. This presentation describes the facilities used at JSC to support AR&C image based tracking development and the details of our binocular stereo approach to image based tracking. Author

N93-22257*# Rockwell International Corp., Downey, CA. Space Systems Div.

AUTOMATED RENDEZVOUS AND PROXIMITY OPERATIONS Abstract Only **c18**

Anton F. Flecklin, II *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

IR&D efforts in recent years have focused on effective means of performing automated rendezvous and proximity operations. The primary focus for application has been to the Space Shuttle Orbiter and potential derivations, such as the Reusable Cargo Vehicle (RCV), studied in FY 1990. All candidate vehicle mission scenarios have included approach to docking or berthing with the Space Station Freedom (SSF). Results to date indicate that application of appropriate guidance algorithms can reduce docking contact or relative offset conditions, resulting in potential simplification of capture systems. Author

N93-22258*# Autonomous Technologies, Orlando, FL.

LADAR VISION TECHNOLOGY FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only **c36**

Randy W. Frey *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

LADAR Vision Technology at Autonomous Technologies Corporation consists of two sensor/processing technology elements: high performance long range multifunction coherent Doppler laser radar (LADAR) technology; and short range integrated CCD camera with direct detection laser ranging sensors. Algorithms and specific signal processing implementations have been simulated for both sensor/processing approaches to position and attitude tracking applicable to AR&C. Experimental data supporting certain sensor measurement accuracies have been generated. Author

N93-22259*# Alabama Univ., Huntsville. Holography, Applied Mechanics, and Photonics Lab.

A PARC SYSTEM FOR TERMINAL DOCKING Abstract Only **c18**

John A. Gilbert and Cheryl D. Bankston *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

A Panoramic viewing system for Automated Rendezvous and Capture (PARC) has been proposed as a visual information feedback system for terminal docking/berthing. The system relies on a unique Panoramic Annular Lens (PAL) which captures an image of its surroundings in real time. This paper describes the evolution of the PAL along with technical details of its imaging capabilities. Several examples are given of radial metrology, where PAL imaging systems are used to perform visual inspections and measurements. Digital image acquisition and processing techniques, used to interpret various features appearing in the images and to transform images for improved human viewing, are also included. These discussions are followed by a potential application for PARC involving berthing of active and passive mechanical assemblies associated with Space Station Freedom. Author

N93-22260*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

DESIGN AND FABRICATION OF AN AUTONOMOUS RENDEZVOUS AND DOCKING SENSOR USING OFF-THE-SHELF HARDWARE Abstract Only **c18**

Gary E. Grimm (TRW, Inc., Redondo Beach, CA.), Thomas C. Bryan, Richard T. Howard, and Michael L. Book *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

NASA Marshall Space Flight Center (MSFC) has developed and tested an engineering model of an automated rendezvous and docking sensor system composed of a video camera ringed with laser diodes at two wavelengths and a standard remote manipulator system target that has been modified with retro-reflective tape and 830 and 780 mm optical filters. TRW has provided additional engineering analysis, design, and manufacturing support, resulting in a robust, low cost, automated rendezvous and docking sensor design. We have addressed the issue of space qualification using off-the-shelf hardware components. We have also addressed the performance problems of increased signal to noise ratio, increased range, increased frame rate, graceful degradation through component redundancy, and improved range calibration. Next year, we will build a breadboard of this sensor. The phenomenology of the background scene of a target vehicle as viewed against earth and space backgrounds under various lighting conditions will be simulated using the TRW Dynamic Scene Generator Facility (DSGF). Solar illumination angles of the target vehicle and candidate docking target ranging from eclipse to full sun will be explored. The sensor will be transportable for testing at the MSFC Flight Robotics Laboratory (EB24) using the Dynamic Overhead Telerobotic Simulator (DOTS). Author

N93-22261*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

VIRTUAL REALITY APPLICATIONS TO AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only **c13**

Joseph Hale and Daniel ONeil *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Virtual Reality (VR) is a rapidly developing Human/Computer Interface (HCI) technology. The evolution of high-speed graphics processors and development of specialized anthropomorphic user interface devices, that more fully involve the human senses, have enabled VR technology. Recently, the maturity of this technology has reached a level where it can be used as a tool in a variety of applications. This paper provides an overview of: VR technology, VR activities at Marshall Space Flight Center (MSFC), applications of VR to Automated Rendezvous and Capture (AR&C), and identifies areas of VR technology that requires further development. Author

N93-22262*# TRW, Inc., Houston, TX.

USE OF NON-SPHERICAL GRAVITY HARMONICS FOR RELATIVE MOTION GN/C (CATEGORY 2) Abstract Only **c18**

David M. Henderson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Detailed analysis of the Automatic Rendezvous and Capture problem indicate a need for three different regions of mathematical description for the GN&C algorithms: (1) multi-vehicle orbital mechanics to the rendezvous interface point, i.e., within 100 nm; (2) relative motion solutions (such as Clohessy-Wiltshire type) from the far-field to the near-field interface, i.e., within 1 nm and; (3) close proximity motion - the near-field motion where the relative differences in the gravitational and orbit inertial accelerations can be neglected from the equations of motion. Limit boundaries to these regions can be precisely defined by further analysis and will be functions of the tracking measurement accuracies and the computer resources available for the solution of the algorithms. This paper analyzes the relative motion in Regions 2 and 3 above and present the derivation and discussion of the general case of non-spherical gravitational perturbed relative motion. Mathematical deviations from the numerically integrated spherical gravity case and solutions from the Clohessy-Wiltshire equations are presented in

the analysis. Based upon this preliminary analysis, it is recommended that further efforts be used to assess the relative position and velocity differences in Region 2 due to non-spherical gravity harmonics and that viable GN&C algorithms be developed to include these gravity perturbations (especially the effects of the first gravity harmonic, J2). Author

N93-22263*# TRW, Inc., Houston, TX.
GN/C TRANSLATION AND ROTATION CONTROL PARAMETERS FOR AR/C (CATEGORY 2) Abstract Only **c18**
David M. Henderson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Detailed analysis of the Automatic Rendezvous and Capture problem indicate a need for three different regions of mathematical description for the GN&C algorithms: (1) multi-vehicle orbital mechanics to the rendezvous interface point, i.e., within 100 n.; (2) relative motion solutions (such as Clohessy-Wiltshire type) from the far-field to the near-field interface, i.e., within 1 nm; and (3) close proximity motion, the nearfield motion where the relative differences in the gravitational and orbit inertial accelerations can be neglected from the equations of motion. This paper defines the reference coordinate frames and control parameters necessary to model the relative motion and attitude of spacecraft in the close proximity of another space system (Region 2 and 3) during the Automatic Rendezvous and Capture phase of an orbit operation. Author

N93-22264*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RESULTS OF PROTOTYPE SOFTWARE DEVELOPMENT FOR AUTOMATION OF SHUTTLE PROXIMITY OPERATIONS Abstract Only **c61**
Harry K. Hiers and Oscar W. Olszewski (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

A Rendezvous Expert System (REX) was implemented on a Symbolics 3650 processor and integrated with the 6 DOF, high fidelity Systems Engineering Simulator (SES) at the NASA Johnson Space Center in Houston, Texas. The project goals were to automate the terminal phase of a shuttle rendezvous, normally flown manually by the crew, and proceed automatically to docking with the Space Station Freedom (SSF). The project goals were successfully demonstrated to various flight crew members, managers, and engineers in the technical community at JSC. The project was funded by NASA's Office of Space Flight, Advanced Program Development Division. Because of the complexity of the task, the REX development was divided into two distinct efforts. One to handle the guidance and control function using perfect navigation data, and another to provide the required visuals for the system management functions needed to give visibility to the crew members of the progress being made towards docking the shuttle with the LVLH stabilized SSF. Author

N93-22265*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SOVIET AUTOMATED RENDEZVOUS AND DOCKING SYSTEM OVERVIEW Abstract Only **c18**
Elaine M. Hinman and David M. Bushman *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 4 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The Soviets have been performing automated rendezvous and docking for many years. This paper will present an overview and brief history of the Soviet AR&D system, based on the open literature and publicly available sources. Author (revised)

N93-22266*# Fairchild Space Co., Germantown, MD.
ON-ORBIT DEMONSTRATION OF AUTOMATED CLOSURE AND CAPTURE USING ESA-DEVELOPED PROXIMITY OPERATIONS TECHNOLOGIES AND AN EXISTING, SERVICEABLE NASA EXPLORER PLATFORM SPACECRAFT Abstract Only **c13**
Bill Hohwiesner and Bernard Claudinon (MATRA Marconi Space, Toulouse, France.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The European Space Agency (ESA) has been working to develop an autonomous rendezvous and docking capability since 1984 to enable Hermes to automatically dock with Columbus. As a result, ESA with Matra, MBB, and other space companies have developed technologies that are also directly supportive of the current NASA initiative for Automated Rendezvous and Capture. Fairchild and Matra would like to discuss the results of the applicable ESA/Matra rendezvous and capture developments, and suggest how these capabilities could be used, together with an existing NASA Explorer Platform satellite, to minimize new development and accomplish a cost effective automatic closure and capture demonstration program. Several RV sensors have been developed at breadboard level for the Hermes/Columbus program by Matra, MBB, and SAAB. Detailed algorithms for automatic rendezvous, closure, and capture have been developed by ESA and CNES for application with Hermes to Columbus rendezvous and docking, and they currently are being verified with closed-loop software simulation. The algorithms have multiple closed-loop control modes and phases starting at long range using GPS navigation. Differential navigation is used for coast/continuous thrust homing, holdpoint acquisition, V-bar hopping, and station point acquisition. The proximity operation sensor is used for final closure and capture. A subset of these algorithms, comprising the proximity operations algorithms, could easily be extracted and tailored to a limited objective closure and capture flight demonstration.

Derived from text

N93-22267*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
VIDEO GUIDANCE SENSOR FOR AUTONOMOUS CAPTURE Abstract Only **c19**
Richard T. Howard and Michael L. Book *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

A video-based sensor has been developed specifically for the close-range maneuvering required in the last phase of autonomous rendezvous and capture. The system is a combination of target and sensor, with the target being a modified version of the standard target used by the astronauts with the Remote Manipulator System (RMS). The system, as currently configured, works well for autonomous docking maneuvers from approximately forty feet in to soft-docking and capture. The sensor was developed specifically to track and calculate its position and attitude relative to a target consisting of three retro-reflective spots, equally spaced, with the center spot being on a pole. This target configuration was chosen for its sensitivity to small amounts of relative pitch and yaw and because it could be used with a small modification to the standard RMS target already in use by NASA. Author (revised)

N93-22268*# Department of the Air Force, Kirtland AFB, NM.
TALON AND CRADLE: SYSTEMS FOR THE RESCUE OF TUMBLING SPACECRAFT AND ASTRONAUTS Abstract Only **c54**
Dunning Idle, V *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Advanced pressure suit and tool designs are beginning to allow extravehicular astronauts to repair space vehicles and so increase mission life and system reliability. A common spacecraft failure that is a severe challenge to the rescue mission planner is loss of attitude control resulting in tumbling motion. If an extravehicular astronaut flying the Manned Maneuvering Unit (MMU) 'falls' into a tumble, the result could be loss of life. TALON (Tumble Arresting Large Oscillation Nullifier) is a device capable of capturing a target in an uncontrolled three-axis tumble. CRADLE (Concentric Rotating Astronaut Detumble Lifesaving Equipment) is a similar device sized to rescue a suited astronaut. The two rescue vehicles work on the same basic principle. They are structural shells with articulated limbs which can surround a tumbling target and thus align both the chaser and target centers of mass (CM). Author (revised)

N93-22269*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SPACE SHUTTLE PROGRAM: AUTOMATIC RENDEZVOUS, PROXIMITY OPERATIONS, AND CAPTURE (CATEGORY 3) Abstract Only **c13**

William L. Jackson, Roscoe Lee (TRW, Inc., Houston, TX.), Richard E. Eick (TRW, Inc., Houston, TX.), J. V. Hallstrom (Rockwell International Corp., Houston, TX.), Harry K. Hiers, John P. McManamen, Oscar W. Olszewski (Lockheed Engineering and Sciences Co., Houston, TX.), Joseph L. Prather, D. L. Rue (TRW, Inc., Houston, TX.), and Karl J. Zimmer *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

The NASA Johnson Space Center is actively pursuing the development and demonstration of capabilities for automatic rendezvous, proximity operations, and capture (AR&C) using the Space Shuttle as the active vehicle. This activity combines the technologies, expertise, tools, and facilities of the JSC Tracking and Communications Division (EE), Navigation, Control and Aeronautics Division (EG), Automation and Robotics Division (ER), and Structures and Mechanics Division (ES) of the Engineering Directorate and the Flight Design and Dynamics Division (DM) of the Mission Operations Directorate. Potential benefits of AR&C include more efficient and repeatable rendezvous, proximity operations, and capture operations; reduced impacts on the target vehicles (e.g., Orbiter RCS plume loads); reduced flight crew work loads; reduced ground support requirements; and reduced operational constraints. This paper documents the current JSC capabilities/tools/facilities for AR&C and describes a proposed plan for a progression of ground demonstrations and flight tests and demonstrations of AR&C capabilities. This plan involves the maturing of existing technologies in tracking and communications; guidance, navigation and control; mechanisms; manipulators; and systems management and integrating them into several evolutionary demonstration stages. Derived from text

N93-22270*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.

CTV RENDEZVOUS TECHNIQUES Abstract Only **c13**

Jerry L. Jennings and Robert L. Anderson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

The cargo transfer vehicle (CTV) requires the capability to perform automated rendezvous with Space Station Freedom (SSF) using onboard sensors and algorithms. The current approach to CTV rendezvous applies techniques developed during the orbital maneuvering vehicle (OMV) program which have been mechanized for automatic, onboard execution. The initial catch up sequence can be described as a passive rendezvous without explicit time of arrival control. The ultimate requirement for this rendezvous technique is to place the CTV on the SSF V-bar axis at some specified downrange distance. The launch vehicle will use yaw steering during orbit injection to achieve the proper phantom plane for nodal biasing. This presentation describes the primary components of the CTV rendezvous scheme. Author (revised)

N93-22271*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.

ON-ORBIT OPERATIONAL SCENARIOS, TOOLS AND TECHNIQUES Abstract Only

Jerry L. Jennings and James Walker *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

This paper concentrates on methods and techniques used to develop operational scenarios for orbital missions, including development of models to analyze alternatives, modification of tools and refinement of techniques for future missions. Many of these tools and techniques have been derived from previous tools, techniques and experience from the Orbital Maneuvering Vehicle (OMV) program. Results from use of these tools show the current Cargo Transfer Vehicle nominal mission scenario, with 95 discrete events defined for the CTV mission from the NLS Heavy Lift Launch Vehicle (HLLV) to Space Station Freedom (SSF). Author (revised)

N93-22272*# General Dynamics Corp., San Diego, CA. Space Systems Div.

AN AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM USING CRUISE MISSILE TECHNOLOGIES Abstract Only **c13**

Ruel Edwin Jones *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

In November 1990 the Autonomous Rendezvous & Docking (AR&D) system was first demonstrated for members of NASA's Strategic Avionics Technology Working Group. This simulation utilized prototype hardware from the Cruise Missile and Advanced Centaur Avionics systems. The object was to show that all the accuracy, reliability and operational requirements established for a space craft to dock with Space Station Freedom could be met by the proposed system. The rapid prototyping capabilities of the Advanced Avionics Systems Development Laboratory were used to evaluate the proposed system in a real time, hardware in the loop simulation of the rendezvous and docking reference mission. The simulation permits manual, supervised automatic and fully autonomous operations to be evaluated. It is also being upgraded to be able to test an Autonomous Approach and Landing (AA&L) system. The AA&L and AR&D systems are very similar. Both use inertial guidance and control systems supplemented by GPS. Both use an Image Processing System (IPS), for target recognition and tracking. The IPS includes a general purpose multiprocessor computer and a selected suite of sensors that will provide the required relative position and orientation data. Graphic displays can also be generated by the computer, providing the astronaut / operator with real-time guidance and navigation data with enhanced video or sensor imagery. Author (revised)

N93-22273*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

OPTICAL CORRELATORS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only **c74**

Richard Juday *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Two dimensional image correlation is a robust technique for recognizing known objects and determining their position with respect to the sensing platform. This capability is of paramount importance to vehicles which must rendezvous and capture using only on-board sensors and processors. Standard digital processors can provide the necessary correlations, but their speed, weight, size and power consumption make them undesirable components of an on-board tracking system. Optical correlators provide correlation results comparable to digital systems, but with a fraction of the size, weight and power and often many times faster. This presentation discusses the application of optical correlators to Automated Rendezvous & Capture (AR&C), and the specific work being done at the Johnson Space Center and DARPA in developing optical correlator technology. Author (revised)

N93-22274*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

AUTOMATIC RENDEZVOUS AND CAPTURE SYSTEM DEVELOPMENT IN A MANNED ENVIRONMENT Abstract Only **c13**

Peter M. Kachmar (Draper, Charles Stark Lab., Inc., Cambridge, MA.) and William L. Jackson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

This paper presents the development of a 'Phase One' AR&C system capability as a logical outgrowth of Rendezvous and Proximity Operations (R&PO) system development for manned space programs. The continuity of the approach to R&PO across the Apollo, Skylab, Apollo-Soyuz, and Shuttle programs is traced and lessons learned which are applicable to AR&C discussed. Use of the Shuttle as a test bed for Automatic Rendezvous and Capture capabilities and technology demonstrations is discussed. A status of the current Phase One System design and brief overview of its capabilities is presented. Author (revised)

N93-22275*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
PERFORMANCE CAPABILITIES OF A PHASE ONE AUTOMATIC RENDEZVOUS AND CAPTURE SYSTEM Abstract Only **c18**
Peter M. Kachmar, Robert J. Polutchko, and Martin Matusky *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

This paper presents an analysis of the performance of the existing 'Phase One' AR&C system developed at the C.S. Draper Laboratory for both the rendezvous and proximity operations mission phases. This material has been developed as a result of Draper Laboratory involvement through NASA's Johnson Space Center in the development of the flight proven IGN&C rendezvous systems for Apollo, Skylab, and Shuttle. The development of these systems using Draper computer simulations has required automation of all crew inputs to the IGN&C system and thus provided the unique opportunity to develop and test those system capabilities required for AR&C. This paper expands upon the material in the papers presented by the authors at the NASA Autonomous Rendezvous and Docking Conference held at JSC on August 15-16, 1991. Author (revised)

N93-22276*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RELATIVE NAVIGATION REQUIREMENTS FOR AUTOMATIC RENDEZVOUS AND CAPTURE SYSTEMS Abstract Only **c17**
Peter M. Kachmar (Draper, Charles Stark Lab., Inc., Cambridge, MA.), Robert J. Polutchko (Draper, Charles Stark Lab., Inc., Cambridge, MA.), William Chu (Draper, Charles Stark Lab., Inc., Cambridge, MA.), and Moises Montez *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

This paper will discuss in detail the relative navigation system requirements and sensor trade-offs for Automatic Rendezvous and Capture. Rendezvous navigation filter development will be discussed in the context of navigation performance requirements for a 'Phase One' AR&C system capability. Navigation system architectures and the resulting relative navigation performance for both cooperative and uncooperative target vehicles will be assessed. Relative navigation performance using rendezvous radar, star tracker, radiometric, laser and GPS navigation sensors during appropriate phases of the trajectory will be presented. The effect of relative navigation performance on the Integrated AR&C system performance will be addressed. Linear covariance and deterministic simulation results will be used. Evaluation of relative navigation and IGN&C system performance for several representative relative approach profiles will be presented in order to demonstrate the full range of system capabilities. A summary of the sensor requirements and recommendations for AR&C system capabilities for several programs requiring AR&C will be presented. Author (revised)

N93-22277*# United Technologies Corp., Huntsville, AL.
AUTOMATED RENDEZVOUS AND CAPTURE SYSTEM Abstract Only **c18**
Jack B. Kader, John H. Caulfield (Alabama Univ., Huntsville.), Chandra S. Vikram (Alabama Univ., Huntsville.), and Steve Patrick *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

This paper describes an ARC system that is an attempt to simplify opration, reduce energy requirements, reduce weight, and provide longterm use and reliability. The ARC system is a laser/optical/holographic (LOH) control system for guidance, rendezvous, and docking (RVD). The LOH/RVD utilizes a hologram, residing at the target platform. Excited by a laser diode, the hologram projects an image at a given distance from the platform. A vision system in the automated chase vehicle sees the projected image and, by optical comparisons, guides the chase vehicle to that image, reaching a proximity conductive to soft docking. The vision system then shifts to a second hologram image holding at close proximity (2mm) to the target platform and guides to it for controlled, precise docking at the rendezvous point. The holographic image projections from the target platform, are composed of color hues and may be circular, triangular or of any other shape and texture that may enhance the ability of the chase vehicle's vision system to analyze information pertinent to velocity, attitude, and roll of the target platform. Any movement of the image, whether planned or errant, will be translated by the vision system into synchronous adjustments throughout the vehicle approach path. Author (revised)

N93-22278*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A COMPARISON OF LASER BASED RANGING SYSTEMS FOR AR/C CATEGORY 1: HARDWARE Abstract Only **c36**
Stephen J. Katzberg and Pleasant W. Goode, IV *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

This paper will present some aspects of the effect of inherent laser effects on the performance of CW-Tone modulated and FM-CW laser ranging techniques. It will be shown that performance of these techniques is affected in different ways by inherent laser characteristics and previous comparisons of the techniques should be modified to reflect more realistic conditions. An overall survey of laser ranging will be given to place the CW and FM-CW techniques in perspective. It will be seen that the newly introduced FM-CW laser radar has potentially far superior performance to CW-Tone modulated systems now proposed for use in space rendezvous and capture systems. Author (revised)

N93-22279*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NEW DEVELOPMENTS IN ASTRODYNAMICS ALGORITHMS FOR AUTONOMOUS RENDEZVOUS Abstract Only **c61**
Allan R. Klumpp *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 4 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

A the core of any autonomous rendezvous guidance system must be two algorithms for solving Lambert's and Kepler's problems, the two fundamental problems in classical astrodynamics. Lambert's problem is to determine the trajectory connecting specified initial and terminal position vectors in a specified transfer time. The solution is the initial and terminal velocity vectors. Kepler's problem is to determine the trajectory that stems from a given initial state (position and velocity). The solution is the state of an earlier or later specified time. To be suitable for flight software, astrodynamics algorithms must be totally reliable, compact, and fast. Although solving Lambert's and Kepler's problems has challenged some of the world's finest minds for over two centuries, only in the last year have algorithms appeared that satisfy all three requirements just stated. This paper presents an evaluation of the most highly regarded Lambert and Kepler algorithms. Author (revised)

N93-22280*# Rockwell International Corp., Houston, TX. Space Operations Div.
ONBOARD NAVIGATION RENDEZVOUS EXPERT SYSTEM Abstract Only **c13**
Michelle Kocen *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The Onboard Navigation rendezvous expert system is designed to aid the ground flight controller in monitoring the shuttle onboard navigation system. The system is designed to keep track of the navigation sensors and relative state vectors. In addition, the system also keeps an event log and fills out forms usually handled by the flight controller. This expert system is one of the few rendezvous specific systems being developed for the Mission Control Center. The expert system has been in development for six years. Through these years the system has seen hardware, software, and personnel changes. Initial development was done by the Information Systems Directorate (ISD) and Mission Operations Directorate (MOD) at Johnson Space Center. As of October 1, 1991 the system has been turned over to MOD. The system is completely developed except for some minor adjustments to the user interface. The rule base is in the verification stage with total certification of the system due to be completed by May 1992. Test cases for verification are obtained by saving data used for flight controller integrated simulations. The actual data comes from both the shuttle mission simulator and the Mission Control Center Computer. So

far no actual flight data has been available. This paper covers all aspects of the system from the development history to the current hardware, software, and use of the system. Author

N93-22281*# General Dynamics Corp., San Diego, CA. Space Systems Div.

AN OVERVIEW OF AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM TECHNOLOGY DEVELOPMENT AT GENERAL DYNAMICS Abstract Only **c13**

Fred Kuenzel *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The Centaur avionics suite is undergoing a dramatic modernization for the commercial, DoD Atlas and Titan programs. The system has been upgraded to the current state-of-the-art in ring laser gyro inertial sensors and Mil-Std-1750A processor technology. The Cruise Missile avionic system has similarly been evolving for many years. Integration of GPS into both systems has been underway for over five years with a follow-on cruise missile system currently in flight test. Rendezvous and Docking related studies have been conducted for over five years in support of OMV, CTV, and Advanced Upper Stages, as well as several other internal IR&D's. The avionics system and AR&D simulator demonstrated to the SATWG in November 1990 has been upgraded considerably under two IR&D programs in 1991. The Centaur modern avionics system is being flown in block upgrades which started in July of 1990. The Inertial Navigation Unit will fly in November of 1991. The Cruise Missile avionics systems have been fully tested and operationally validated in combat. The integrated AR&D system for space vehicle applications has been under development and testing since 1990. A Joint NASA / GD ARD&L System Test Program is currently being planned to validate several aspects of system performance in three different NASA test facilities in 1992. Author (revised)

N93-22282*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

AUTONOMOUS DOCKING GROUND DEMONSTRATION (CATEGORY 3) Abstract Only **c13**

Steve L. Lamkin, Richard E. Eick (TRW, Inc., Houston, TX.), James M. Baxter (TRW, Inc., Houston, TX.), M. G. Boyd (Lockheed Engineering and Sciences Co., Houston, TX.), Fred D. Clark (Lockheed Engineering and Sciences Co., Houston, TX.), Thomas Q. Lee, L. T. Othon, Joseph L. Prather, Peter T. Spehar (Lockheed Engineering and Sciences Co., Houston, TX.), and Rebecca J. Teders (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The NASA Johnson Space Center (JSC) is involved in the development of an autonomous docking ground demonstration. The demonstration combines the technologies, expertise and facilities of the JSC Tracking and Communications Division (EE), Structures and Mechanics Division (ES), and the Navigation, Guidance and Control Division (EG) and their supporting contractors. The autonomous docking ground demonstration is an evaluation of the capabilities of the laser sensor system to support the docking phase (12ft to contact) when operated in conjunction with the Guidance, Navigation and Control Software. The docking mechanism being used was developed for the Apollo Soyuz Test Program. This demonstration will be conducted using the Six-Degrees of Freedom (6-DOF) Dynamic Test System (DTS). The DTS environment simulates the Space Station Freedom as the stationary or target vehicle and the Orbiter as the active or chase vehicle. For this demonstration the laser sensor will be mounted on the target vehicle and the retroreflectors on the chase vehicle. This arrangement was used to prevent potential damage to the laser. The sensor system. GN&C and 6-DOF DTS will be operated closed-loop. Initial condition to simulate vehicle misalignments, translational and rotational, will be introduced within the constraints of the systems involved. Detailed description of each of the demonstration components (e.g., Sensor System, GN&C, 6-DOF DTS and supporting computer configuration) including their capabilities and limitations will be discussed. A demonstration architecture drawing and photographs of the test configuration will be presented. Author (revised)

N93-22283*# Motorola, Inc., Chandler, AZ. Strategic Electronics Div.

RENDEZVOUS RADAR FOR THE ORBITAL MANEUVERING VEHICLE Abstract Only **c32**

John W. Locke, Keith Olds, and Howard Parks *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

This paper describes the development of the Rendezvous Radar Set (RRS) for the Orbital Maneuvering Vehicle (OMV) for the National Aeronautics and Space Administration (NASA). The RRS was to be used to locate, and then provide vectoring information to, target satellites (or Shuttle or Space Station) to aid the OMV in making a minimum-fuel-consumption approach and rendezvous. The RRS design is that of an X-Band, all solid-state, monopulse tracking, frequency hopping, pulse-Doppler radar system. The development of the radar was terminated when the OMV prime contract to TRW was terminated by NASA. At the time of the termination, the development was in the circuit design stage. The system design was virtually completed, the PDR had been held. The RRS design was based on Motorola's experiences, both in the design and production of radar systems for the US Army and in the design and production of hi-rel communications systems for NASA space programs. Experience in these fields was combined with the latest digital signal processor and micro-processor technology to design a light-weight, low-power, spaceborne radar. The antenna and antenna positioner (gimbals) technology developed for the RRS is now being used in the satellite-to-satellite communication link design for Motorola's Iridium telecommunications system.

Author (revised)

N93-22284*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

AUTONOMOUS RENDEZVOUS TARGETING TECHNIQUES FOR NATIONAL LAUNCH SYSTEM APPLICATION Abstract Only **c13**

James J. Lomas and A. Wayne Deaton *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The rendezvous targeting techniques that can be utilized to achieve autonomous guidance for delivering a cargo to Space Station Freedom (SSF) using the National Launch System's (NLS) Heavy Lift Launch Vehicle (HLLV) and the on-orbit Cargo Transfer Vehicle (CTV) are described. This capability is made possible by advancements in autonomous navigation (Global Positioning System - GPS) on-board the CTV and SSF as well as the new generation flight computers. How the HLLV launch window can be decoupled from the CTV phasing window is described. The performance trades that have to be made to determine the length of the launch window and the phasing window between the CTV and SSF are identified and recommendations made that affect mission timelines. Author (revised)

N93-22285*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INTELLIGENT SYSTEMS TECHNOLOGY INFRASTRUCTURE FOR INTEGRATED SYSTEMS Abstract Only **c63**

Henry Lum, Jr. *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Significant advances have occurred during the last decade in intelligent systems technologies (a.k.a. knowledge-based systems, KBS) including research, feasibility demonstrations, and technology implementations in operational environments. Evaluation and simulation data obtained to date in real-time operational environments suggest that cost-effective utilization of intelligent systems technologies can be realized for Automated Rendezvous and Capture applications. The successful implementation of these technologies involve a complex system infrastructure integrating the requirements of transportation, vehicle checkout and health management, and communication systems without compromise to systems reliability and performance. The resources that must be invoked to accomplish these tasks include remote ground operations and control, built-in system fault management and control, and intelligent robotics. To ensure long-term evolution and integration of new validated technologies over the lifetime of the vehicle, system interfaces must also be addressed and integrated into the overall system interface requirements. An approach for defining and

evaluating the system infrastructures including the testbed currently being used to support the on-going evaluations for the evolutionary Space Station Freedom Data Management System is presented and discussed. Intelligent system technologies discussed include artificial intelligence (real-time replanning and scheduling), high performance computational elements (parallel processors, photonic processors, and neural networks), real-time fault management and control, and system software development tools for rapid prototyping capabilities. Author (revised)

N93-22286*# General Dynamics Corp., San Diego, CA. Space Systems Div.

DGPS FOR SPACE AND RETURN Abstract Only **c18**

Stanley C. Maki *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

A different type of differential global positioning system (DGPS) configuration is described and compared to the standard DGPS configuration. Implementation options for either configuration for space and return are discussed. Author (revised)

N93-22287*# Lockheed Missiles and Space Co., Houston, TX.

AN AUTOMATED RENDEZVOUS AND CAPTURE SYSTEM DESIGN CONCEPT FOR THE CARGO TRANSFER VEHICLE AND SPACE STATION FREEDOM Abstract Only **c18**

Ron Fuchs and Steven Marsh *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

A rendezvous sensor system concept was developed for the cargo transfer vehicle (CTV) to autonomously rendezvous with and be captured by Space Station Freedom (SSF). The development of requirements, the design of a unique Lockheed developed sensor concept to meet these requirements, and the system design to place this sensor on the CTV and rendezvous with the SSF are described . Author (revised)

N93-22288*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SUPERVISED AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEMS TECHNOLOGY EVALUATIONS Abstract Only **c18**

Neville I. Marzwell *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

(RTOP 906-00-00)

Avail: CASI HC A01/MF A03

The Jet Propulsion Laboratory, employing the technology assessment that resulted from the Autonomous Rendezvous and Docking Conference held at the Lyndon B. Johnson Space Center on 15-16 Aug. 1990 as the basis undertook a literature search and contacts with major national and international aerospace companies to perform an assessment of the existing technologies and those that are needed to accomplish supervised autonomous rendezvous and docking in space. The following five issues are covered: (1) lessons learned; (2) technology assessment for navigation and guidance sensors for Autonomous Rendezvous and Docking (AR&D); (3) technology assessment of Guidance, Navigation and Controls (GN&C), techniques for rendezvous and docking; (4) docking mechanisms; and (5) space and ground operations. Author (revised)

N93-22289*# Lockheed Engineering and Sciences Co., Houston, TX. Intelligent Systems Dept.

A NAVIGATION AND CONTROL SYSTEM FOR AN AUTONOMOUS RESCUE VEHICLE IN THE SPACE STATION ENVIRONMENT Abstract Only **c17**

Lawrence Merkel *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

(Contracts NAS9-15800; NAS9-17900)

Avail: CASI HC A01/MF A03

A navigation and control system was designed and implemented for an orbital autonomous rescue vehicle envisioned to retrieve astronauts or equipment in the case that they become disengaged from the space station. The rescue vehicle, termed the Extra-Vehicular Activity Retriever (EVAR), has an on-board inertial measurement unit ahd GPS receivers for self state estimation, a laser range imager (LRI) and cameras for object state estimation, and a data link for reception of space station state information. The states of the retriever and objects (obstacles and the target object) are estimated by inertial state propagation which is corrected via measurements from the GPS, the LRI system, or the camera system. Kalman filters are utilized to perform sensor fusion and estimate the state propagation errors. Control actuation is performed by a Manned Maneuvering Unit (MMU). Phase plane control techniques are used to control the rotational and translational state of the retriever. The translational controller provides station-keeping or motion along either Clohessy-Wiltshire trajectories or straight line trajectories in the LVLH frame of any sufficiently observed object or of the space station. The software was used to successfully control a prototype EVAR on an air bearing floor facility, and a simulated EVAR operating in a simulated orbital environment. The design of the navigation system and the control system are presented. Also discussed are the hardware systems and the overall software architecture.

Author (revised)

N93-22290*# Lockheed Missiles and Space Co., Palo Alto, CA.

OPTICAL PHASE MEASURING SENSORS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only **c74**

Wayne Metheny and Mark Malin *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

A technique is described for sensing relative spatial orientations of approach and target vehicles, using optical phase mensuration (in the interferometric sense, as opposed to LIDAR), in place of the more conventional intensity, image, or transit time measurements. This approach permits the parameters to be measured with great accuracy with relatively simple, small sensors having no moving components. A suite of sensors operating on this principle can produce all desired data using either active detection on the target or passive retroreflection to the detectors on the approach vehicle. These optical phase measurements can be applied to determine bearing angle (location of the target vehicle in the approach vehicle coordinates), range, and attitude (orientation of the target vehicle with respect to the line-of-sight). The first two quantities require the approach vehicle to project a modulated interference pattern into space. The bearing angle is determined for a selected point on the target by measuring the phase of the interference pattern at that point using either a detector on the target or a retroreflector on the target and a detector at the transmitter. The range is found by measuring differential bearing angles to predetermined relative instrumentation sites. Two interferometers, a coarse and a fine ranger are required to resolve the 2pi ambiguity. Author

N93-22291*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

MAGNETIC END EFFECTORS FOR SPACE OPERATIONS Abstract Only **c19**

Leo Monford and Edward L. Carter (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

The Magnetic End Effector (MEE) to be flown as part of the Dexterous End Effector (DEE) flight experiment was designed to operate with the Shuttle Remote Manipulator System (SRMS). Grappling or attachment of payloads is accomplished magnetically with two fault tolerant operations. The small magnetic grapple plate weighs far less than the standard grapple fixture; allows stacking and close spacing of payloads; and eliminates secondary release mechanisms. In addition to specifics regarding the MEE, the DEE project, Magnetic Attachment Tool (MAT), RMS-Force Torque Sensor (RMS-FTS), and Targeting and Reflective Alignment Concept (TRAC) are discussed. Author (revised)

N93-22292*# McDonnell-Douglas Space Systems Co., Houston, TX.

USE OF AUTOMATED RENDEZVOUS TRAJECTORY PLANNING TO IMPROVE SPACECRAFT OPERATIONS EFFICIENCY Abstract Only **c13**

Tom A. Mulder *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For

primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The current planning process for space shuttle rendezvous with a second Earth-orbiting vehicle is time consuming and costly. It is a labor-intensive, manual process performed pre-mission with the aid of specialized maneuver processing tools. Real-time execution of a rendezvous plan must closely follow a predicted trajectory, and targeted solutions leading up to the terminal phase are computed on the ground. Despite over 25 years of Gemini, Apollo, Skylab, and shuttle vehicle-to-vehicle rendezvous missions flown to date, rendezvous in Earth orbit still requires careful monitoring and cannot be taken for granted. For example, a significant trajectory offset was experienced during terminal phase rendezvous of the STS-32 Long Duration Exposure Facility retrieval mission. Several improvements can be introduced to the present rendezvous planning process to reduce costs, produce more fuel-efficient profiles, and increase the probability of mission success. Author

N93-22293*# General Dynamics Corp., San Diego, CA. Space Systems Div.
AN INTEGRATED AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM ARCHITECTURE USING CENTAUR MODERN AVIONICS Abstract Only **c13**
Kurt Nelson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The avionics system for the Centaur upper stage is in the process of being modernized with the current state-of-the-art in strapdown inertial guidance equipment. This equipment includes an integrated flight control processor with a ring laser gyro based inertial guidance system. This inertial navigation unit (INU) uses two MIL-STD-1750A processors and communicates over the MIL-STD-1553B data bus. Commands are translated into load activation through a Remote Control Unit (RCU) which incorporates the use of solid state relays. Also, a programmable data acquisition system replaces separate multiplexer and signal conditioning units. This modern avionics suite is currently being enhanced through independent research and development programs to provide autonomous rendezvous and docking capability using advanced cruise missile image processing technology and integrated GPS navigational aids. A system concept was developed to combine these technologies in order to achieve a fully autonomous rendezvous, docking, and autoland capability. The current system architecture and the evolution of this architecture using advanced modular avionics concepts being pursued for the National Launch System are discussed. Author (revised)

N93-22294*# TRW, Inc., Redondo Beach, CA. Engineering and Test Div.
COLLISION AVOIDANCE FOR CTV: REQUIREMENTS AND CAPABILITIES Abstract Only **c13**
Thomas P. Nosek *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Cargo transfer vehicle (CTV) operations near Space Station Freedom will require positive collision avoidance maneuver (CAM) capability to preclude any change of collision, even in the event of CTV failures. The requirements for CAM are discussed, and the CAM design approach and design of the Orbiting Maneuvering Vehicle (OMV) are reviewed; this design met requirements for OMV operation near the Space Station, provided a redundant collision avoidance maneuver capability. Significant portions of the OMV CAM design should be applicable to CTV. The key features of the OMV design are summarized and related to the CTV mission design to that of OMV's. CAM is a defined sequence of events executed by the CTV to place the vehicle in a safe position relative to a target such as the Space Station. CAM can be performed through software commands to the propulsion system, or through commands pre-stored in hardware. Various techniques for triggering CAM are considered, and the risks associated with CAM enable and execution in phases are considered. OMV CAM design features both hardware and software CAM capability, with analyses conducted to assess the ability to meet the collision-free requirement during all phases of the mission. Author (revised)

N93-22295*# McDonnell-Douglas Space Systems Co., Houston, TX.
PILOTING DECISION AID FOR SPACECRAFT PROXIMITY OPERATIONS Abstract Only **c13**
Cole J. Pierce *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The concept of a decision aid to assist the piloting of a powered vehicle during a near-field (less than 2000 feet) rendezvous to another spacecraft is discussed. Using Space Shuttle rendezvous with an orbiting satellite as an example, extensive practice is normally required to successfully effect such a rendezvous with a minimum of propellant. As a rule, variations on a 'point and shoot' technique are optimized and used as much as possible. A piloting decision aid (PDA) to assist in the pointing process was conceived and is in the preliminary stages of development. This concept may be applied to Space Shuttle proximity operations for berthing with Space Station Freedom (SSF), for Shuttle rendezvous with other spacecraft, or for autonomous rendezvous of any unmanned vehicle with SSF. The concept orginated with a task order from NASA JSC for an automated piloting procedure and was influenced by an early air-to-air missile envelope display. Author (revised)

N93-22296*# McDonnell-Douglas Space Systems Co., Houston, TX.
SPACECRAFT RENDEZVOUS OPERATIONAL CONSIDERATIONS AFFECTING VEHICLE SYSTEMS DESIGN AND CONFIGURATION Abstract Only **c18**
Ellen E. Prust *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

One lesson learned from Orbiting Maneuvering Vehicle (OMV) program experience is that Design Reference Missions must include an appropriate balance of operations and performance inputs to effectively drive vehicle systems design and configuration. Rendezvous trajectory design is based on vehicle characteristics (e.g., mass, propellant tank size, and mission duration capability) and operational requirements, which have evolved through the Gemini, Apollo, and STS programs. Operational constraints affecting the rendezvous final approach are summarized. The two major objectives of operational rendezvous design are vehicle/crew safety and mission success. Operational requirements on the final approach which support these objectives include: tracking/targeting/communications; trajectory dispersion and navigation uncertainty handling; contingency protection; favorable sunlight conditions; acceptable relative state for proximity operations handover; and compliance with target vehicle constraints. A discussion of the ways each of these requirements may constrain the rendezvous trajectory follows. Although the constraints discussed apply to all rendezvous, the trajectory presented in 'Cargo Transfer Vehicle Preliminary Reference Definition' (MSFC, May 1991) was used as the basis for the comments below. Author (revised)

N93-22297*# Rockwell International Corp., Seal Beach, CA.
APPROACH RANGE AND VELOCITY DETERMINATION USING LASER SENSORS AND RETROREFLECTOR TARGETS Abstract Only **c36**
L. Race, K. J. Kim, J. Wang, W. Schoknecht, and William J. Donovan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Rockwell International is conducting an ongoing program to develop Laser Docking Sensors (LDS) that provide high performance and high intrinsic value while meeting all mission objectives. These LDS systems are now being required to aid future spacecraft docking, station keeping, and berthing/capture systems. Improved automated tracking, rendezvous, soft docking, and capture will be required in the construction and support of SSF and future orbiting platforms. The development of a practical LDS requires an easy-to-operate, low-cost, compact system. A wide range of options for laser range detection equipment, ranging from commercial technology to specialized military systems, was evaluated. This evaluation focused on both direct applicability of existing systems and usability of specific technologies contained in these systems. From these efforts it was determined that a new approach provided the greatest promise of

fulfilling all mission requirements at the lowest life-cycle cost.
Author (revised)

N93-22298*# Applied Research, Inc., Huntsville, AL.
AUTOMATED RENDEZVOUS AND DOCKING WITH VIDEO IMAGERY Abstract Only **c13**
Mike Rodgers and Larry Z. Kennedy *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

For rendezvous and docking, assessing and tracking relative orientation is necessary within a minimum approach distance. Special target light patterns have previously been considered for use with video sensors for ease of determining relative orientation. A generalization of those approaches is addressed. At certain ranges, the entire structure of the target vehicle constitutes an acceptable target; at closer ranges, substructures will suffice. Acting on the same principle as the human intelligence, these structures can be compared with a memory model to assess the relative orientation and range. Models for comparison are constructed from a CAD facet model and current imagery. This approach requires fast image handling, projection, and comparison techniques which rely on rapidly developing parallel processing technology. Relative orientation and range assessment consists of successful comparison of the perceived target aspect with a known aspect. Generating a known projection from a model within required times, say subsecond times, is only now approaching feasibility. With this capability, rates of comparison used by the human brain can be approached and arbitrary known structures can be compared in reasonable times. Future space programs will have access to powerful computation devices which far exceed even this capability. For example, the possibility will exist to assess unknown structures and then control rendezvous and docking, all at very fast rates. The first step which has the current utility, namely applying this to known structures, is taken. Author (revised)

N93-22299*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.
SIX DEGREE OF FREEDOM SIMULATION SYSTEM FOR EVALUATING AUTOMATED RENDEZVOUS AND DOCKING SPACECRAFT Abstract Only **c13**
Kenneth H. Rourke and Roy K. Tsugawa *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Future logistics supply and servicing vehicles such as cargo transfer vehicles (CTV) must have full 6 degree of freedom (6DOF) capability in order to perform requisite rendezvous, proximity operations, and capture operations. The design and performance issues encountered when developing a 6DOF maneuvering spacecraft are very complex with subtle interactions which are not immediately obvious or easily anticipated. In order to deal with these complexities and develop robust maneuvering spacecraft designs, a simulation system and associated family of tools are used at TRW for generating and validating spacecraft performance requirements and guidance algorithms. An overview of the simulator and tools is provided. These are used by TRW for autonomous rendezvous and docking research projects including CTV studies. Author (revised)

N93-22300*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PROPOSED CTV DESIGN REFERENCE MISSIONS IN SUPPORT OF SPACE STATION FREEDOM Abstract Only **c18**
Rudy J. Saucillo (McDonnell-Douglas Space Systems Co., Rockville, MD.) and William M. Cirillo *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Use of design reference missions (DRM's) for the cargo transfer vehicle (CTV) in support of Space Station Freedom (SSF) can provide a common baseline for the design and assessment of CTV systems and mission operations. These DRM's may also provide baseline operations scenarios for integrated CTV, Shuttle, and SSF operations. Proposed DRM's for CTV, SSF, and Shuttle operations envisioned during the early post-PMC time frame and continuing through mature, SSF evolutionary operations are described. These proposed DRM's are outlines for detailed mission definition; by treating these DRM's as top-level input for mission design studies, a range of parametric studies for systems/operations may be performed. Shuttle flight design experience, particularly rendezvous flight design, provides an excellent basis for DRM operations studies. To begin analysis of the DRM's, shuttle trajectory design tools were used in single case analysis to define CTV performance requirements. A summary of these results is presented. Author (revised)

N93-22301*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OFFICE OF SPACE FLIGHT STANDARD SPACEBORNE GLOBAL POSITIONING SYSTEM USER EQUIPMENT PROJECT Abstract Only **c17**
Penny E. Saunders *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The Global Positioning System (GPS) provides users autonomous, real-time navigation capability. A vehicle equipped with GPS user equipment can receive and process signals transmitted by a constellation of GPS satellites and derive from the resulting measurements the vehicle's position and velocity. Specified accuracies range from 16 to 76 meters and 0.1 to 1.0 meters/second for position and velocity, respectively. In a rendezvous and docking scenario, the use of a technique called relative GPS can provide range and range rate accuracies on the order of 1 meter and 0.01 meters/second, respectively. Relative GPS requires both vehicles to be equipped with GPS user equipment and a data communication link for transmission of GPS data and GPS satellite selection coordination information. Through coordinated satellite selection, GPS measurement errors common to both users are cancelled and improved relative position and velocity accuracies are achieved. The background, the design approach, the expected performance and capabilities, the development plan, and the project status are described. In addition, a description of relative GPS, the possible GPS hardware and software configurations, and its application to automated rendezvous and capture are presented. Author (revised)

N93-22302*# General Dynamics Corp., San Diego, CA. Space Systems Div.
THE DEVELOPMENT OF AN AUTONOMOUS RENDEZVOUS AND DOCKING SIMULATION USING RAPID INTEGRATION AND PROTOTYPING TECHNOLOGY Abstract Only **c13**
John H. Shackelford, John D. Saugen, Michael J. Wurst, and James Adler *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

A generic planar 3 degree of freedom simulation was developed that supports hardware in the loop simulations, guidance and control analysis, and can directly generate flight software. This simulation was developed in a small amount of time utilizing rapid prototyping techniques. The approach taken to develop this simulation tool, the benefits seen using this approach to development, and on-going efforts to improve and extend this capability are described. The simulation is composed of 3 major elements: (1) Docker dynamics model, (2) Dockee dynamics model, and (3) Docker Contrcl System. The docker and dockee models are based on simple planar orbital dynamics equations using a spherical earth gravity model. The docker control system is based on a phase plane approach to error correction.
Author (revised)

N93-22303*# Martin Marietta Corp., Denver, CO. Astronautics Group.
PHOTONIC CORRELATOR PATTERN RECOGNITION: APPLICATION TO AUTONOMOUS DOCKING Abstract Only **c19**
Gary W. Sjolander *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Optical correlators for real-time automatic pattern recognition applications have recently become feasible due to advances in high speed devices and filter formulation concepts. The devices are discussed in the context of their use in autonomous docking. Author (revised)

N93-22304*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.

SIMULATION MODELS FOR AUTONOMOUS RENDEZVOUS AND CAPTURE Abstract Only **c13**

Nick G. Smith, Jim A. McKinnis, and Sid M. Early *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Autonomous rendezvous and capture (AR&C) is a critical space technology with significant application to a variety of missions. Martin Marietta Astronautics Group (MMAG) has been developing AR&C technical capability in support of several recent NASA contracts. The use of AR&C for the Mars Rover/Sample Return (MRSR) mission was studied through a contract with JSC. Incorporation of AR&C in the Space Transportation Vehicle (STV) lunar mission was studied through a contract with MSFC. The MMAG has also been developing AR&C simulation capability under independent research and development studies. Simulation development was driven by two goals: comprehensive software simulation of the autonomous rendezvous and capture mission from launch to final capture; and integration of the overall software and hardware simulation to support an AR&C flight demonstration. This presentation will highlight the AR&C software simulation tools and analyze results from their application to the STV lunar mission. Plans for an integrated software and hardware simulation will also be summarized. Author (revised)

N93-22305*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

AUTOMATING AN ORBITER APPROACH TO SPACE STATION FREEDOM TO MINIMIZE PLUME IMPINGEMENT Abstract Only **c13**

Peter T. Spehar (Lockheed Engineering and Sciences Co., Houston, TX.) and Thomas Quan Le *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The Space shuttle orbiter Reaction Control System's (RCS) plume impingement during proximity operations with Space Station Freedom (SSF) is a structural design driver for the SSF solar panels and radiators. A study underway at JSC is investigating whether the use of an automated approach controller could result in the reduction of plume impingement induced loads during orbiter approach to SSF. Ongoing real time person-in-the-loop (PIL) simulations of an orbiter approaching the SSF show that orbiter trajectory control can vary significantly from one pilot to the next. This variation is a cause for concern since current analyses predict that plume impingement loads resulting from PIL orbiter approaches may exceed the solar panel and radiator load limits. The use of an automated approach controller is expected to reduce peak loads by both minimizing orbiter translational jet firings in certain directions and controlling the frequency at which they occur during various phases of the approach. Author (revised)

N93-22306*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.

CONTACT DYNAMICS TESTING OF AUTOMATED THREE POINT DOCKING MECHANISM Abstract Only **c18**

Christopher J. Spitzer *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

TRW has conducted an extensive Contact Dynamics Test Program (CDTP) of the Three Point Docking Mechanism (TPDM). The CDTP tested the ability of the TPDM latches to capture and automatically dock to target spacecraft. The target selected was the Hubble Space Telescope (HST). Mock ups of the TPDM with its three latches and the docking interface of the HST were constructed at the Marshall Space Flight Center (MSFC) in Huntsville, Alabama for use in the tests. The tests were performed at the Flat Floor and Six Degree of Freedom (6-DOF) facilities at MSFC. Author

N93-22307*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.

EXPERIMENTAL VALIDATION OF DOCKING AND CAPTURE USING SPACE ROBOTICS TESTBEDS Abstract Only **c14**

John Spofford, Eric Schmitz, and William Hoff *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

This presentation describes the application of robotic and computer vision systems to validate docking and capture operations for space cargo transfer vehicles. Three applications are discussed: (1) air bearing systems in two dimensions that yield high quality free-flying, flexible, and contact dynamics; (2) validation of docking mechanisms with misalignment and target dynamics; and (3) computer vision technology for target location and real-time tracking. All the testbeds are supported by a network of engineering workstations for dynamic and controls analyses. Dynamic simulation of multibody rigid and elastic systems are performed with the TREETOPS code. MATRIXx/System-Build and PRO-MATLAB/Simulab are the tools for control design and analysis using classical and modern techniques such as H-infinity and LQG/LTR. SANDY is a general design tool to optimize numerically a multivariable robust compensator with a user-defined structure. Mathematica and Macsyma are used to derive symbolically dynamic and kinematic equations. Author (revised)

N93-22308*# McDonnell-Douglas Space Systems Co., Houston, TX.

PROXIMITY OPERATIONS CONSIDERATIONS AFFECTING SPACECRAFT DESIGN Abstract Only **c18**

Steven K. Staas *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

Experience from several recent spacecraft development programs, such as Space Station Freedom (SSF) and the Orbital Maneuvering Vehicle (OMV) has shown the need for factoring proximity operations considerations into the vehicle design process. Proximity operations, those orbital maneuvers and procedures which involve operation of two or more spacecraft at ranges of less than one nautical mile, are essential to the construction, servicing, and operation of complex spacecraft. Typical proximity operations considerations which drive spacecraft design may be broken into two broad categories; flight profile characteristics and concerns, and use of various spacecraft systems during proximity operations. Proximity operations flight profile concerns include the following: (1) relative approach/separation line; (2) relative orientation of the vehicles; (3) relative translational and rotational rates; (4) vehicle interaction, in the form of thruster plume impingement, mating or demating operations, or uncontrolled contact/collision; and (5) active vehicle piloting. Spacecraft systems used during proximity operations include the following: (1) sensors, such as radar, laser ranging devices, or optical ranging systems; (2) effector hardware, such as thrusters; (3) flight control software; and (4) mating hardware, needed for docking or berthing operations. A discussion of how these factors affect vehicle design follows, addressing both active and passive/cooperative vehicles. Author (revised)

N93-22309*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

THE MSFC SPACE STATION/SPACE OPERATIONS MECHANISM TEST BED Abstract Only **c14**

William G. Sutton and Patrick A. Tobbe (Logicon Control Dynamics Co., Huntsville, AL.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

The Space Station/Space Operations Mechanism Test Bed consists of the following: a hydraulically driven, computer controlled Six Degree-of-Freedom Motion System (6DOF); a six degree-of-freedom force and moment sensor; remote driving stations with computer generated or live TV graphics; and a parallel digital processor that performs calculations to support the real time simulation. The function of the Mechanism Test Bed is to test docking and berthing mechanisms for Space Station Freedom and other orbiting space vehicles in a real time, hardware-in-the-loop simulation environment. Typically, the docking and berthing mechanisms are composed of two mating components, one for each vehicle. In the facility, one component is attached to the motion system, while the other component is mounted to the force/moment sensor fixed in the support structure above the 6DOF. The six components of the contact forces/moments acting on the test article and its mating component are measured by the force/moment sensor. Author (revised)

N93-22310*# General Dynamics Corp., San Diego, CA. Space Systems Div.

THE ROLE OF SMART SYSTEMS IN RENDEZVOUS, CLOSE PROXIMITY OPERATIONS AND DOCKING MANEUVERS Abstract Only **c14**

Gerard P. Szatkowski *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Various missions scenarios (Space Station logistics, LEO and GEO services, and SEI operation) will involve flexibility in mission management. This means operations will be one or a combination of the following: autonomous, supervised autonomous, and machine aided manual control. Smart Systems will likely play a significant role in making these missions successful from a safety/reliability perspective and less costly from an operations perspective. This does not imply that Smart Systems need to be super sophisticated. On the contrary, Smart Systems have been described as automated intelligence that if a person had done it wrong, it would be considered stupid. The first part of this paper will describe the types of Smart System techniques involved in AR and CC, their specifications, duties, and interactions. Next will be a discussion of the work performed under the auspice of the ALS Program to further Expert Systems applications imbedded in the control process, NASA/JSC CRAD, and other related IRAD projects. This will include issues pertaining to the following: integration, speed, knowledge encapsulation, and cooperative systems. Finally, a brief description will be offered to outline the major obstacles for the acceptance of Smart Systems in critical applications. Author (revised)

N93-22311*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.

GUIDELINE REQUIREMENTS FOR SERVICEABLE SPACECRAFT GRASPING/BERTHING/DOCKING INTERFACES BASED ON SIMULATIONS AND FLIGHT EXPERIENCE (SURVEY PAPER) Abstract Only **c18**

Allen B. Thompson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

As space vehicles and structures become larger and more complex, the development of systems to assist humans in assembling, operating, maintaining, and performing space rescue or retrieval of these vehicles and structures becomes increasingly important. With the diversity of international spacecraft, both manned and unmanned, planned to be in orbit in the future, a set of guidelines for berthing and docking subsystems is mandatory if servicing, resupply, and retrieval is to become practical on an international level. Successful interaction between these space systems and ground and/or space-based humans requires standardized and effective operational interface designs, particularly with respect to space grasping/berthing/docking interface mechanisms. This paper defines the spacecraft mechanical interfaces necessary to create a standard dynamic envelope for joining two free-flying spacecraft in a 'hard' berth or dock with each other in space. A review was made of past space flights and dynamics simulations dating back to 1962 to obtain necessary parameters and their values for successful manually controlled and autonomous spacecraft docking/berthing. The various spacecraft docking/berthing mechanisms and concepts are illustrated along with their dynamic capture and impact tolerances including maximum contact velocity along the approach axis and in the y-z plane; capture linear misalignment tolerances; and maximum capture roll, pitch, and yaw angles. From this data sets of recommended guidelines parameters were developed for autonomous and manual impact docking tolerances, non-impact grasping/berthing tolerances (end effectors), berthing contact conditions, and alignment tolerances after rigidizing. Also, detailed requirements were developed for mechanical design interface features, as well as latching, unlatching, and separation tolerances. This data was drafted in the form of a proposed ANSI Standard guideline, reviewed, and added to by members of the committee representing several spacecraft manufacturers, NASA, and the USAF, and a consensus was reached. Author (revised)

N93-22312*# Logicon Control Dynamics Co., Huntsville, AL.

AUTOMATIC RENDEZVOUS SYSTEM TESTING AT THE FLIGHT ROBOTICS LABORATORY Abstract Only **c14**

Patrick A. Tobbe and Charles B. Naumann *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

(Contract NAS8-36570)

Avail: CASI HC A01/MF A03

The Flight Robotics Laboratory of MSFC provides sophisticated real time simulation capability in the study of human/system interactions of remote systems. This paper will describe the Flight Robotics Facility of NASA/MSFC, the hardware-in-the-loop simulation configuration, and test results. Author (revised)

N93-22313*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

THRUSTER CONFIGURATIONS FOR MANEUVERING HEAVY PAYLOADS Abstract Only **c20**

Roy K. Tsugawa (TRW, Inc., Redondo Beach, CA.), Michael E. Draznin (TRW, Inc., Redondo Beach, CA.), and Richard W. Dabney *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

The cargo transfer vehicle (CTV) will be required to perform six degree of freedom (6DOF) maneuvers while carrying a wide range of payloads varying from 100,000 lbm to no payload. The current baseline design configuration for the CTV uses a forward propulsion module (FPM) mounted in front of the payload and the CTV behind the payload so that the center of gravity (CG) of the combined stack is contained between the thruster sets. This allows for efficient rotation and translations of heavy payloads in all directions; however, the FPM is a costly item, so it is desirable to find design solutions which do not require the FPM. This presentation provides an overview of the work performed in analyzing the FPM requirements for the CTV. Specifically, key issues related to thruster configuration requirements for operating the CTV without the FPM, throughout the 100,000 lbm payload to no payload range, will be highlighted. In this study, only the reaction control system (RCS) thruster configurations are considered and the orbit adjust engines are not addressed. An important output of this study is the viable alternative thruster configurations which eliminate the need for the FPM. Initial results were derived using analytical techniques and simulation analysis tools. Results from the preliminary analysis were used as inputs for our 6DOF simulation. The 6DOF simulation was used to validate our design guidelines and to verify the performance of the thruster configurations. Author (revised)

N93-22314*# McDonnell-Douglas Space Systems Co., Huntington Beach, CA. Advanced Products Development and Technology Div.

ELECTRO-OPTICAL RENDEZVOUS AND DOCKING SENSORS Abstract Only **c19**

David J. Tubbs, Lynn O. Kesler, and Robert J. Sirko *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Electro-optical sensors provide unique and critical functionality for space missions requiring rendezvous, docking, and berthing. McDonnell Douglas is developing a complete rendezvous and docking system for both manned and unmanned missions. This paper examines our sensor development and the systems and missions which benefit from rendezvous and docking sensors. Simulation results quantifying system performance improvements in key areas are given, with associated sensor performance requirements. A brief review of NASA-funded development activities and the current performance of electro-optical sensors for space applications is given. We will also describe current activities at McDonnell Douglas for a fully functional demonstration to address specific NASA mission needs. Author

N93-22315*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CONCURRENT-SCENE/ALTERNATE-PATTERN ANALYSIS FOR ROBUST VIDEO-BASED DOCKING SYSTEMS Abstract Only **c18**

Suraphol Udomkesmalee *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

A typical docking target employs a three-point design of retroreflective tape, one at each endpoint of the center-line, and one on the tip of the

central post. Scenes, sensed via laser diode illumination, produce pictures with spots corresponding to desired reflection from the retroreflectors and other reflections. Control corrections for each axis of the vehicle can then be properly applied if the desired spots are accurately tracked. However, initial acquisition of these three spots (detection and identification problem) are non-trivial under a severe noise environment. Signal-to-noise enhancement, accomplished by subtracting the non-illuminated scene from the target scene illuminated by laser diodes, can not eliminate every false spot. Hence, minimization of docking failures due to target mistracking would suggest needed inclusion of added processing features pertaining to target locations. In this paper, we present a concurrent processing scheme for a modified docking target scene which could lead to a perfect docking system. Since the non-illuminated target scene is already available, adding another feature to the three-point design by marking two non-reflective lines, one between the two end-points and one from the tip of the central post to the center-line, would allow this line feature to be picked-up only when capturing the background scene (sensor data without laser illumination). Therefore, instead of performing the image subtraction to generate a picture with a high signal-to-noise ratio, a processed line-image based on the robust line detection technique (Hough transform) can be used to fuse with the actively sensed three-point target image to deduce the true locations of the docking target. This dual-channel confirmation scheme is necessary if a fail-safe system is to be realized from both the sensing and processing point-of-views. Detailed algorithms and preliminary results are presented.

Author (revised)

N93-22316*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

AUTONOMOUS RECONFIGURABLE GPS/INS NAVIGATION AND POINTING SYSTEM FOR RENDEZVOUS AND DOCKING Abstract Only **c17**

Triveni N. Upadhyay (Mayflower Communications Co., Inc., Reading, MA.), Stephen Cotterill (Mayflower Communications Co., Inc., Reading, MA.), and A. Wayne Deaton *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

This paper describes the results of an integrated navigation and pointing system software development effort sponsored by the NASA MSFC through a SBIR Phase 2 Program. The integrated Global Positioning System (GPS)/Inertial Navigation System (INS) implements an autonomous navigation filter that is reconfigurable in real-time to accommodate mission contingencies. An onboard expert system monitors the spacecraft status and reconfigures the navigation filter accordingly, to optimize the system performance. The navigation filter is a multi-mode Kalman filter to estimate the spacecraft position, velocity, and attitude. Three different GPS-based attitude determination techniques, namely, velocity vector matching, attitude vector matching, and interferometric processing, are implemented to encompass different mission contingencies. The integrated GPS/INS navigation filter will use any of these techniques depending on the mission phase and the state of the sensors. The first technique, velocity vector matching, uses the GPS velocity measurement to estimate the INS velocity errors and exploits the correlation between INS velocity and attitude errors to estimate the attitude. The second technique, attitude vector matching, uses INS gyro measurements and GPS carrier phase (integrated Doppler) measurements during a spacecraft rotation maneuver to determine the attitude. Both of these techniques require only one GPS antenna onboard to determine the spacecraft attitude. The third technique, interferometric processing, requires use of multiple GPS antennae. In order to determine 3-axis body attitude, three GPS antennae (2 no-coplanor baselines) are required.

Author (revised)

N93-22317*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

A BERTHING AND FASTENING STRATEGY FOR ORBITAL REPLACEMENT UNITS Abstract Only **c18**

John Vranish and Edward Cheung *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

Research in the area of berthing of Orbital Replacement Units (ORU's) at the GSFC consists of two major parts. First, we concentrate on the development of a comprehensive fastening strategy that can provide both mechanical as well as electrical connection to the ORU. Second, our efforts in robot collision avoidance and motion planning have led to the development of a state-of-the-art capacitive proximity sensor with associated motion control algorithms. These efforts combine to produce a system that allows safe and reliable machine assisted berthing. Although our main emphasis was on berthing of ORU's, we believe that some of our results can also be applied to docking.

Author (revised)

N93-22318*# Microcosm, Inc., Torrance, CA.

FULLY AUTONOMOUS NAVIGATION FOR THE NASA CARGO TRANSFER VEHICLE Abstract Only **c17**

James R. Wertz and E. David Skulsky *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

A great deal of attention has been paid to navigation during the close approach (less than or equal to 1 km) phase of spacecraft rendezvous. However, most spacecraft also require a navigation system which provides the necessary accuracy for placing both satellites within the range of the docking sensors. The Microcosm Autonomous Navigation System (MANS) is an on-board system which uses Earth-referenced attitude sensing hardware to provide precision orbit and attitude determination. The system is capable of functioning from LEO to GEO and beyond. Performance depends on the number of available sensors as well as mission geometry; however, extensive simulations have shown that MANS will provide 100 m to 400 m (3(sigma)) position accuracy and 0.03 to 0.07 deg (3(sigma)) attitude accuracy in low Earth orbit. The system is independent of any external source, including GPS. MANS is expected to have a significant impact on ground operations costs, mission definition and design, survivability, and the potential development of very low-cost, fully autonomous spacecraft.

Author (revised)

N93-22319*# Lockheed Engineering and Sciences Co., Houston, TX. Man Systems/Human Factors Engineering Dept.

EMPLOYING LIGHTING TECHNIQUES DURING ON-ORBIT OPERATIONS Abstract Only **c18**

Charles D. Wheelwright and Jennifer R. Toole *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)

Avail: CASI HC A01/MF A03

As a result of past space missions and evaluations, many procedures have been established and shown to be prudent applications for use in present and future space environment scenarios. However, recent procedures to employ the use of robotics to assist crewmembers in performing tasks which require viewing remote and obstructed locations have led to a need to pursue alternative methods to assist in these operations. One of those techniques which is under development entails incorporating the use of suitable lighting aids/techniques with a closed circuit television (CCTV) camera/monitor system to supervise the robotics operations. The capability to provide adequate lighting during grappling, deploying, docking and berthing operations under all on-orbit illumination conditions is essential to a successful mission. Using automated devices such as the Remote Manipulator System (RMS) to dock and berth a vehicle during payload retrieval, under nighttime, earthshine, solar, or artificial illumination conditions can become a cumbersome task without first incorporating lighting techniques that provide the proper target illumination, orientation, and alignment cues. Studies indicate that the use of visual aids such as the CCTV with a pretested and properly oriented lighting system can decrease the time necessary to accomplish grappling tasks. Evaluations have been and continue to be performed to assess the various on-orbit conditions in order to predict and determine the appropriate lighting techniques and viewing angles necessary to assist crewmembers in payload operations.

Author (revised)

N93-22320*# Logicon Control Dynamics Co., Huntsville, AL.

METHODS FOR MODELING CONTACT DYNAMICS OF CAPTURE MECHANISMS Abstract Only **c37**

Philip J. Williams, Patrick A. Tobbe, and John Glaese *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p Sponsored in cooperation with Boeing Aerospace

and Electronics Co. (For primary document see N93-22226 08-12)
(Contracts NAS8-36570; NAS8-36417)
Avail: CASI HC A01/MF A03

In this paper, an analytical approach for studying the contact dynamics of space-based vehicles during docking/berthing maneuvers is presented. Methods for modeling physical contact between docking/berthing mechanisms, examples of how these models have been used to evaluate the dynamic behavior of automated capture mechanisms, and experimental verification of predicted results are shown. Author

N93-22321*# General Dynamics/Convair, San Diego, CA.
AR/D IMAGE PROCESSING SYSTEM Abstract Only **c18**
Cathy Wookey and Bruce Nicholson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

General Dynamics has developed advanced hardware, software, and algorithms for use with the Tomahawk cruise missile and other unmanned vehicles. We have applied this technology to the problem of locating and determining the orientation of the docking port of a target vehicle with respect to an approaching spacecraft. The system described in this presentation utilizes a multi-processor based computer to digitize and process television imagery and extract parameters such as range to the target vehicle, approach, velocity, and pitch and yaw angles. The processor is based on the Inmos T-800 Transputer and is configured as a loosely coupled array. Each processor operates asynchronously and has its own local memory. This allows additional processors to be easily added if additional processing power is required for more complex tasks. Total system throughput is approximately 100 MIPS (scalar) and 60 MFLOPS and can be expanded as desired. The algorithm implemented on the system uses a unique adaptive thresholding technique to locate the target vehicle and determine the approximate position of the docking port. A target pattern surrounding the port is than analyzed in the imagery to determine the range and orientation of the target. This information is passed to an autopilot which uses it to perform course and speed corrections. Future upgrades to the processor are described which will enhance its capabilities for a variety of missions. Author (revised)

N93-22383*# National Aeronautics and Space Administration, Washington, DC.
UNIVERSITY GUIDE TO NASA, 1993
Oct. 1992 56 p
(NASA-EP-287; NAS 1.19:287) Avail: CASI HC A04/MF A01

This guide provides brief descriptions of the two NASA Headquarters program offices through which NASA primarily funds universities, the Office of Space Science and Applications and the Office of Aeronautics and Space Technology. It also describes NASA's Office of Commercial Programs, which funds the Centers for the Commercial Development of Space and the Small Business Innovation Research Program. This guide explains the roles played by NASA's eight field centers and the Jet Propulsion Laboratory, and gives a sampling of ongoing NASA-wide educational programs and services. Most importantly, this guide provides practical information in the form of names and telephone numbers of NASA contacts.
Derived from text

N93-22468*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEMONSTRATION PLAN FOR REAL TIME RECEIVING AND PROCESSING OF FLIGHT DATA FROM THE SPACE TRANSPORTATION SYSTEM
James W. Russell (Lockheed Engineering and Sciences Co., Hampton, VA.) and Don E. Avery Jan. 1993 24 p
(RTOP 506-48-42-01)
(NASA-TM-107725; NAS 1.15:107725) Avail: CASI HC A03/MF A01

This report presents a detailed demonstration test plan for receiving and processing data from experiments being conducted on the Space Transportation System near real time at the NASA Langley Research Center (LaRC). This task can readily be achieved using the Orbital Acceleration Research Experiment (OARE). The Space Shuttle data flow is described including both the payload and the mission data. A description is presented of the OARE instrument which is used to measure low frequency Space Shuttle accelerations in nano-gs. Procedures are shown for obtaining the required mission data and OARE paylcad data at LaRC. The demonstration test plan schedule and costs are presented. It is recommended that both the OARE data and the pertinent Space Shuttle mission data be received at LaRC over the NASA Communication System (NASCOM) on a near real time basis. Author

N93-22870*# National Aeronautics and Space Administration, Washington, DC.
FLIGHT PROJECT DATA BOOK
National Aeronautics and Space Administration 1992 147 p
(NASA-TM-108657; NAS 1.26:108657) Avail: CASI HC A07/MF A02

The Office of Space Science and Applications (OSSA) is responsible for the overall planning, directing, executing, and evaluating that part of the overall NASA program that has the goal of using the unique characteristics of the space environment to conduct a scientific study of the universe, to understand how the Earth works as an integrated system, to solve practical problems on Earth, and to provide the scientific and technological research foundation for expanding human presence beyond Earth orbit into the solar system. OSSA guides its program toward leadership through its pursuit of excellence across the full spectrum of disciplines. OSSA pursues these goals through an integrated program of ground-based laboratory research and experimentation, suborbital flight of instruments on airplanes, balloons, and sounding rockets; flight of instruments and the conduct of research on the Shuttle/Spacelab system and on Space Station Freedom; and development and flight of automated Earth-orbiting and interplanetary spacecraft. The OSSA program is conducted with the participation and support of other Government agencies and facilities, universities throughout the United States, the aerospace contractor community, and all of NASA's nine Centers. In addition, OSSA operates with substantial international participation in many aspects of our Space Science and Applications Program. OSSA's programs currently in operation, those approved for development, and those planned for future missions are described. Derived from text

N93-23032*# National Aeronautics and Space Administration, Washington, DC.
TRANSPORTATION TECHNOLOGY PROGRAM: STRATEGIC PLAN
Sep. 1991 98 p
(NASA-TM-108706; NAS 1.15:108706) Avail: CASI HC A05/MF A02

The purpose of this report is to define the technology program required to meet the transportation technology needs for current and future civil space missions. It is a part of an integrated plan, prepared by NASA in part in response to the Augustine Committee recommendations, to describe and advocate expanded and more aggressive efforts in the development of advanced space technologies. This expanded program will provide a technology basis for future space missions to which the U.S. aspires, and will help to regain technology leadership for the U.S. on a broader front. The six aspects of this integrated program/plan deal with focused technologies to support space sciences, exploration, transportation, platforms, and operations as well as provide a Research and Technology Base Program. This volume describes the technologies needed to support transportation systems, e.g., technologies needed for upgrades to current transportation systems and to provide reliable and efficient transportation for future space missions. The Office of Aeronautics, Exploration, and Technology (OAET) solicited technology needs from the major agency technology users and the aerospace industry community and formed a transportation technology team (appendix A) to develop a technology program to respond to those needs related to transportation technologies. This report addresses the results of that team activity. It is a strategic plan intended for use as a planning document rather than as a project management tool. It is anticipated that this document will be primarily utilized by research & technology (R&T) management at the various NASA Centers as well as by officials at NASA Headquarters and by industry in planning their corporate Independent Research and Development (IR&D) investments. Author

N93-23033*# General Research Corp., Vienna, VA.
RESEARCH AND TECHNOLOGY GOALS AND OBJECTIVES FOR INTEGRATED VEHICLE HEALTH MANAGEMENT (IVHM)
10 Oct. 1992 32 p Prepared in cooperation with Orbital Technologies Corp., Madison, WI

(Contract NASw-4470)
(NASA-CR-192656; NAS 1.26:192656) Avail: CASI HC A03/MF A01

Integrated Vehicle Health Management (IVHM) is defined herein as the capability to efficiently perform checkout, testing, and monitoring of space transportation vehicles, subsystems, and components before, during, and after operational This includes the ability to perform timely status determination, diagnostics, and prognostics. IVHM must support fault-tolerant response including system/subsystem reconfiguration to prevent catastrophic failures; and IVHM must support the planning and scheduling of post-operational maintenance. The purpose of this document is to establish the rationale for IVHM and IVHM research and technology planning, and to develop technical goals and objectives. This document is prepared to provide a broad overview of IVHM for technology and advanced development activities and, more specifically, to provide a planning reference from an avionics viewpoint under the OAST Transportation Technology Program Strategic Plan. Derived from text

N93-23054*# Houston Univ., TX. Sasakawa International Center for Space Architecture.
FIRST LUNAR OUTPOST SUPPORT STUDY
Christopher Bartz, John Cook, and Jean-Luc Rusingizandekwe Apr. 1993 80 p
(Grant NAG9-591)
(NASA-CR-192843; NAS 1.26:192843) Avail: CASI HC A05/MF A01

The First Lunar Outpost (FLO) is the first manned step in the accomplishment of the Space Exploration Initiative, the Vice President's directive to NASA on the 20th anniversary of the Apollo moon landing. FLO's broad objectives are the establishment of a permanent human presence on the moon, supporting the utilization of extraterrestrial resources in a long-term, sustained program. The primary objective is to emplace and validate the first elements of a man tended outpost on the lunar surface to provide the basis for: (1) establishing, maintaining and expanding human activities and influence across the surface; (2) establishing, maintaining and enhancing human safety and productivity; (3) accommodating space transportation operations to and from the surface; (4) accommodating production of scientific information; (5) exploiting in-situ resources. Secondary objectives are: (1) to conduct local, small scale science (including life science); (2) In-situ resource utilization (ISRU) demonstrations; (3) engineering and operations tests; (4) to characterize the local environment; and (5) to explore locally. The current work is part of ongoing research at the Sasakawa International Center for Space Architecture supporting NASA's First Lunar Outpost initiative. Research at SICSA supporting the First Lunar Outpost initiative has been funded through the Space Exploration Initiatives office at Johnson Space Center. The objectives of the current study are to further develop a module concept from an evaluation of volumetric and programmatic requirements, and pursue a high fidelity design of this concept, with the intention of providing a high fidelity design mockup to research planetary design issues and evaluate future design concepts. Derived from text

N93-23103# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: SPACE
25 Mar. 1993 81 p Transl. into ENGLISH from various Russian articles (JPRS-USP-93-001) Avail: CASI HC A05/MF A01

Translated articles cover the following topics: manned mission highlights; space sciences; interplanetary sciences; space engineering; space applications; and space policy, administration. Author

N93-23156 Space Foundation, Colorado Springs, CO.
THE EIGHTH NATIONAL SPACE SYMPOSIUM
Beth Ann Lipskin, ed., David A. Brescia, ed., Jerry Brown, ed., Donna Burk, ed., Sharon Crawford, ed., Robin Dailey, ed., Jack Flannery, ed., John A. Gimarc, ed., Chuck Zimkas, ed., and Aimee Blagg et al 1992 300 p Symposium held in Colorado Springs, CO, 31 Mar. - 3 Apr., 1992
Original contains color illustrations
(ISBN-0-9616962-5-7) Copyright Avail: CASI HC A13/MF A03; 7 functional color pages

This is a compilation of comments made by key space policy decision makers. Participants include civil, military, commercial, and international decision makers. The United States Foundation was founded to stimulate dialogue on space policy issues, to encourage educational excellence through curriculum enrichment with space resources, and to develop programs that enhance public understanding of space and how advanced technologies increase America's competitiveness in the world. For individual titles, see N93-23157 through N93-23165.

N93-23157 Space Foundation, Colorado Springs, CO.
NEW LAUNCH TECHNOLOGIES AND AMERICAN COMPETITIVENESS
Charles Conrad, Jr. (McDonnell-Douglas Space Systems Co., Huntington Beach, CA.), Robert Barthelemy (Air Force Systems Command, Wright-Patterson AFB, OH.), William A. Gaubatz (McDonnell-Douglas Space Systems Co., Huntington Beach, CA.), and Stephanie Myers (Department of Transportation, Washington, DC.) *In its* The Eighth National Space Symposium 1992 p 41-5 (For primary document see N93-23156 08-12)
Copyright Avail: CASI HC A03/MF A03; 7 functional color pages

This is a discussion on technology for launching single-stage-to-orbit rockets and on the national aerospace plane (NASP). Also discussed are some commercial opportunities that can be opened up by having better access to space. CASI

N93-23158 Space Foundation, Colorado Springs, CO.
TECHNOLOGY UTILIZATION AND AMERICAN COMPETITIVENESS
Frank Penaranda (National Aeronautics and Space Administration, Washington, DC.), Ray Arnold (National Aeronautics and Space Administration, Washington, DC.), and Fred Fetterolf (Alcoa Foundation, Pittsburgh, PA.) *In its* The Eighth National Space Symposium 1992 p 60-6 (For primary document see N93-23156 08-12)
Copyright Avail: CASI HC A02/MF A03; 7 functional color pages

This session of discussions reports on two sides of the technology transfer issue. The speakers are representatives of the aluminum industry (Alcoa Aluminum) and the National Aeronautics and Space Administration, Office of Commercial Programs. They discuss what technology transfer means, what NASA does for industry, and how information is disseminated. CASI

N93-23159 Space Foundation, Colorado Springs, CO.
OUTLOOK FOR THE U.S. SPACE PROGRAM
Doug Morrow (Morrow, Doug, Glendale, CA.), William M. Braselton, Jr. (Harris Corp., Melbourne, FL.), James D. A. vanHoften (Bechtel National, Inc., San Francisco, CA.), and Thomas F. Rogers (Sophron Foundation, McLean, VA.) *In its* The Eighth National Space Symposium 1992 p 69-8 (For primary document see N93-23156 08-12)
Copyright Avail: CASI HC A03/MF A03; 7 functional color pages

The future of the United States space program is discussed, including the goals, the vision, the voter support, lack of concensus about the proper paths to pursue, economic factors, leadership, and space commercialization. The discussion concluded with a challenge to NASA to do more to reach the public in terms that they can understand regarding spinoffs from, or technology utilization of, new materials and techniques developed by the space program. CASI

N93-23160 Space Foundation, Colorado Springs, CO.
SPACE SUPPORT FORUM
Wesley W. Posvar (Posvar, Wesley, Pittsburgh, PA.), Donald A. Laidlaw (Department of Education, Washington, DC.), Robert Brown (National Aeronautics and Space Administration, Washington, DC.), Douglas King (Challenger Center, Alexandria, VA.), Daniel O. Graham (High Frontier, Inc., Arlington, VA.), Linda Strine (Department of Transportation, Washington, DC.), Mark Hopkins (Spacecause, Santa Monica, CA.), and Carl McNair (McNair, Robert E. Foundation, Inc., Atlanta, GA.) *In its* The Eighth National Space Symposium 1992 p 82-102 (For primary document see N93-23156 08-12)
Copyright Avail: CASI HC A03/MF A03; 7 functional color pages

This is a report of the discussions held by the Space Support Forum on the subject of education as an investment in the future. The Space Support Forum is a gathering of representatives of various space-related organizations that interact or overlap with the mission of the Space Foundation. They reported that an international science assessment in 17 countries ranked the United States either near or at the bottom in biology, chemistry, and physics. The U.S. Department of Education has laid out 6 National Education Goals to turn this status around and is helping hundreds

of communities to work towards these goals, referred to as America 2000. CASI

N93-23161 Space Foundation, Colorado Springs, CO.
MILITARY SPACE CAPABILITIES AND REQUIREMENTS
Donald J. Kutyna (North American Air Defense Command, Peterson AFB, CO.), Michael W. Keaveney (Department of the Army, Washington, DC.), Herbert Browne (Department of the Navy, Washington, DC.), Thomas S. Moorman, Jr. (Department of the Air Force, Washington, DC.), Jerry Tuttle (Department of the Navy, Washington, DC.), Robert Dickman (Department of the Air Force, Washington, DC.), Louis A. DelRosso (Department of the Air Force, Washington, DC.), James Carlson (Strategic Defense Initiative Organization, Washington, DC.), and Richard McCormick (Department of the Air Force, Washington, DC.) *In its* The Eighth National Space Symposium 1992 p 103-148 (For primary document see N93-23156 08-12)
Copyright Avail: CASI HC A03/MF A03; 7 functional color pages

Representatives of the space commands of the three branches of U.S. military service discuss military aspects of space. The speakers' experience includes peacetime problems, domestic and international policies, and expertise in science, technology, and engineering. Specific topics addressed include operational capabilities and activities, contributions to the Gulf War, space initiatives, and responsibilities such as astronaut oversight, support of imaging and tracking radars, network control, and missile defense. CASI

N93-23162 Space Foundation, Colorado Springs, CO.
INDUSTRY PERSPECTIVES
Don Fuqua (Aerospace Industries Association of America, Inc., Washington, DC.), Tim Hannemann (TRW Space and Defense Sector, Redondo Beach, CA.), Sam F. Iacobellis (Rockwell International Corp., Seal Beach, CA.), and A. Thomas Young (Martin Marietta Aerospace, Bethesda, MD.) *In its* The Eighth National Space Symposium 1992 p 149-168 (For primary document see N93-23156 08-12)
Copyright Avail: CASI HC A03/MF A03; 7 functional color pages

This discussion addresses the question of whether or not the space industry will take up the slack in the aerospace industry that is created by budget cuts in defense. Armed forces' research has provided an invaluable base for national technological and engineering resources for aerospace companies. It is noted that the space program should maximize the country's advances in national, scientific, and technical capabilities. It is also noted that NASA has done well in a most complicated business, but that Congress has failed to make a firm commitment to NASA's plans outlined in Vision 21 (based on the Augustine report) as evidenced by the Congressional reactions to NASA's budget requests. International cooperation and competition are discussed as well as the need for a political concensus on the direction of the space program in the U.S. CASI

N93-23163 Space Foundation, Colorado Springs, CO.
NASA REPORTS
John E. OBrien (National Aeronautics and Space Administration, Washington, DC.), Lennard A. Fisk (National Aeronautics and Space Administration, Washington, DC.), Arnold A. Aldrich (National Aeronautics and Space Administration, Washington, DC.), Thomas E. Utsman (National Aeronautics and Space Administration, Washington, DC.), Michael D. Griffin (National Aeronautics and Space Administration, Washington, DC.), and Aaron Cohen (National Aeronautics and Space Administration, Washington, DC.) *In its* The Eighth National Space Symposium 1992 p 179-209 (For primary document see N93-23156 08-12)
Copyright Avail: CASI HC A03/MF A03; 7 functional color pages

Activities and National Aeronautics and Space Administration (NASA) programs, both ongoing and planned, are described by NASA administrative personnel from the offices of Space Science and Applications, Space Systems Development, Space Flight, Exploration, and from the Johnson Space Center. NASA's multi-year strategic plan, called Vision 21, is also discussed. It proposes to use the unique perspective of space to better understand Earth. Among the NASA programs mentioned are the Magellan to Venus and Galileo to Jupiter spacecraft, the Cosmic Background Explorer, Pegsat (the first Pegasus payload), Hubble, the Joint U.S./German ROSAT X-ray Mission, Ulysses to Jupiter and over the sun, the Astro-Spacelab Mission, and the Gamma Ray Observatory. Copies of viewgraphs that illustrate some of these missions, and others, are provided. Also discussed were life science research plans, economic factors as they relate to space missions, and the outlook for international cooperation. CASI

N93-23164 Space Foundation, Colorado Springs, CO.
INTERNATIONAL COOPERATION AND COMMITMENTS IN THE ISY AND BEYOND
John L. McLucas (External Tanks Corp., Alexandria, VA.), Hiroe Fujioka (Institute for Future Technology, Tokyo, Japan.), Ian Pryke (European Space Agency, Washington, DC.), and Dietmar Wurzel (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Washington, DC.) *In its* The Eighth National Space Symposium 1992 p 210-221 (For primary document see N93-23156 08-12)
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The question of international pooling of resources for space missions is addressed. The impetus towards such cooperation is both financial and technological. Functions, examples, plans, and objectives for international cooperation are discussed, and the European Space Agency (ESA) is presented as an example of successful cooperation among nations in pursuit of common space-related goals. The International Space Year is also mentioned. Its theme is space and the service of the changing Earth. CASI

N93-23165 Space Foundation, Colorado Springs, CO.
PUBLIC CONGRESSIONAL FORUM ON SPACE
Jake Garn (Congress of the United States, Washington, DC.), Hank Brown (Congress of the United States, Washington, DC.), Joel Hefley (Congress of the United States, Washington, DC.), and Jim Chapman (Congress of the United States, Washington, DC.) *In its* The Eighth National Space Symposium 1992 p 223-256 (For primary document see N93-23156 08-12)
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The discussion began with comments on the returns to the private sector of eight or nine dollars for every dollar spent on the space program, on the lack of knowledge or understanding evidenced by both the public and people in Congress of the benefits resulting from the space program, and on the seriousness of the U.S. budget problems. The second speaker focussed on projects that he felt are top priorities: ballistic missile defense, research in the use of space, and the development of new power plants, new engines, and new means of propulsion. The next speaker stressed the need for consensus and unified commitment on a national space goal. The final speaker addressed the money problems. He expressed the hope that the final programs and policies that the nation decided upon would both make sense and be affordable. CASI

N93-23385*# Office of Space Science and Applications, Washington, DC.
FLIGHT PROJECT DATA BOOK, 1991
1991 109 p
(NASA-TM-108656; NAS 1.15:108656) Avail: CASI HC A06/MF A02

The Office of Space Science and Applications (OSSA) is responsible for planning, directing, executing, and evaluating that part of the overall NASA program that has as its goal the use of the unique characteristics of the space environment to conduct a scientific study of the universe, to solve practical problems on Earth, and to provide the scientific research foundation for expanding human presence beyond Earth into the solar system. OSSA manages the development of NASA's flight instrumentation for space science and applications including free flying spacecraft, Shuttle and Space Station payloads, and the suborbital sounding rockets, balloons, and aircraft programs. A summary is provided of future flight missions, including those approved and currently under development and those which appear in the OSSA strategic plan. Author

N93-24336# European Space Agency, Paris (France).
ENVIRONMENT OBSERVATION AND CLIMATE MODELLING THROUGH INTERNATIONAL SPACE PROJECTS. COLUMBUS EIGHT (COSY-8): UTILISATION OF EARTH ORBITING LABORATORIES
T. Duc Guyenne, ed. and James J. Hunt, ed. Jul. 1992 366 p Conference held in Munich, Germany, 30 Mar. - 4 Apr. 1992; sponsored by EEC, ESA, Deutsche Agentur fuer Raumfahrtangelegenheiten, and the European Association for the International Space Year

(ESA-ISY-4; ETN-93-93507) Copyright Avail: CASI HC A16/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The European International Space Year conference was held with the specific theme of the practical use of space derived information for environmental research and monitoring and resource management. This main theme, 'Mission to Planet Earth,' was maintained, but it was recognized that other fields needed to be equally addressed to provide a balanced view on space activities. Space sciences, space navigation and communications, and manned space activities were also represented. The present volume focuses on the utilization aspects of Columbus and of the precursor flights Spacelab and Eureca. Other Earth orbiting laboratories, notably the Space Station Mir, are also addressed. Climate modeling, high energy astrophysics, and manned spaceflight are addressed. The need to find a sensible equilibrium between development, operations, and utilization, and on the other hand between cost, capability, and utilization return is stressed. For individual titles, see N93-24337 through N93-24406.

N93-24337# European Space Agency, Paris (France). Space Station and Microgravity Div.

COLUMBUS PROGRAMME OVERVIEW **c45**

F. Engstroem *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 9-10 (For primary document see N93-24336 08-12)

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The main events which have characterized the Columbus program over the last year are summarized. Since the proposal was deemed too expensive, modifications in the technical baseline and, consequently, an updating of the cost estimates were performed. The present situation is clarified: continuity along the established baseline with, in addition, a perspective of a budgetary austerity over the next 3 to 4 years and the encouragement of international cooperation. The plan and perspective for future development of the Columbus program are addressed: these include discussions with the Russians on work towards the Free Flyer baseline and on more regular utilization of the Space Station Mir by ESA astronauts; and the need of precursor flights to respond to user needs for opportunities, both in microgravity and the technology demonstration areas. ESA

N93-24338# Alenia Spazio S.p.A., Rome (Italy).

THE PROSPECTS OF THE COLUMBUS PROGRAMME TEN YEARS AFTER ITS INITIATION **c18**

Ernesto Vallerani *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 11-14 (For primary document see N93-24336 08-12)

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A possible evolution of Columbus, bearing in mind the changes in the situation that have occurred over the last decade, is described. The ultimate goals that the program can realistically achieve in the international exploitation of space are focused upon. The large infrastructures which were conceived many years ago as an area of international cooperation in the conquest of space, and which started at the beginning of the 1980's with the Space Station and Columbus programs, have undergone a difficult development over the last decade and have had to suffer the resulting delays. The economic difficulties which faced the spacefaring nations, including Europe, in this period have led to much replanning and reprogramming which, together with the upheavals in the East, have demanded a rethinking of the strategies to achieve the original goals as fully as possible. The role of the Columbus Attached laboratory, or Attached Pressurized Module, as a European contribution to Space Station Freedom, in its new configuration dictated by the problems the U.S. has had to confront, is highlighted as an area for new strategies. Its basic features and characteristics are described. With regard to the Free Flying Laboratory, the prospects for this element will be the subject of new thinking, especially in the light of new international cooperation. ESA

N93-24339# National Space Development Agency, Tokyo (Japan). Space Experiment Group.

JEM PROGRAM STATUS **c18**

Masatoshi Saito *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 15-18 (For primary document see N93-24336 08-12)

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Progress in the Japanese Experimental Module (JEM) program is addressed. The JEM contractor Preliminary Design Review (PDR) has been completed; construction of JEM operation facilities has begun, and the micro G airplane, drop shaft, and micro G sounding rocket are all in operation. The national policy for JEM utilization will soon be established. The space Experiment Laboratory (SEL) will open in Jun. 1992 and will function as a user support center. Eight JEM multiuser facilities are in phase B. Seventeen candidate multiuser facilities are going to be defined as to scientific requirements. The national Joint Research Program is about to start. Precursor mission and early Space Station utilization activities are being defined. ESA

N93-24340# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Microgravity User Support Center.

USER SUPPORT FOR THE SPACELAB MISSION D-2 **c29**

D. Padeken, M. Schuber, F. Gillessen, R. Naehle, and G. Schmitz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 19-24 (For primary document see N93-24336 08-12)

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The Microgravity User Support Center (MUSC), which supports 75 experiments on five multiuser facilities onboard Spacelab-2, is addressed. The user support program started in early 1988 with classical tasks such as parameter definition. The engineering models (EM's) of the flight facilities (the functionally equivalent hardware), the key elements of the whole user support program used throughout all phases of the mission, for experiment preparation, experiment execution, and experiment evaluation, are addressed. Details of each of these experiment stages are given. The EM's at MUSC are embedded within a 'living' laboratory environment. Additionally, MUSC developed tools for data handling, facility commanding, and data evaluation complement the infrastructure for the operation of the EM's. These tools are the GSPE (Ground Support Program Equipment) and the HOLOP telescience workstation. They are prerequisites for the operation of space experiments in the telescience mode and became an internal standard within MUSC. This year the user support program will focus on the preparation of mission support and on ground reference experiments like Baseline Data Collection (BDC) and Experiment Sequence Tests (EST). ESA

N93-24341# Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn (Germany).

COLUMBUS PRECURSOR SPACELAB MISSIONS

W. U. Klein and V. Sobick (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 27-30 (For primary document see N93-24336 08-12)

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The use of the Columbus precursor Spacelab missions in performing the interlink between standard Spacelab missions as represented by the missions D1 and D2 and crewed Columbus utilization is discussed. These missions, which preliminarily provide for repetitive flight opportunities to the user community, shall prepare the Space Station era with respect to technical concepts, involvement of user and engineering centers and modified operations. A core payload for Spacelab mission E1 consisting of different multiuser facilities and stand alone instruments has been roughly accommodated. This serves as the basis for further iterations with respect to a balanced utilization of the onboard resources by experiments from different disciplines. ESA

N93-24342# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Crew Operations Dept.

PAYLOAD OPERATIONS FOR PRECURSOR MISSION E-1

Karl Ludwig Mueller *In* ESA, Environment Observation and Climate

Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 31-35 (For primary document see N93-24336 08-12)
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Payload operations of the Spacelab D2 mission are described. Building upon the expertise accumulated, a concept for payload operations of E1 was developed, incoporating Columbus aspects where compatible with the constraints of a spacelab mission. At the same time, however, an effective and safe mode of payload operations is to be guaranteed without compromise to science while adhering to standards and regulations of NASA. ESA

N93-24343# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). ESA Space Station and Platforms Directorate.
THE EURECA CONCEPT AND MISSIONS
R. D. Andresen *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 37-39 (For primary document see N93-24336 08-12)
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The design philosophy of Eureca (European Retrieval Carrier) and its specific cost and efficiency characteristics are explained. Details of its data handling systems are given as well as its payload resources and accommodation flexibility. The payload and the corresponding experiments of the Eureca-1 mission are described. ESA

N93-24344# Italian Space Agency, Rome.
THE ROLE OF THE APM CENTRE TO SUPPORT COLUMBUS PRECURSOR FLIGHTS **c14**
Giovanni Rum, Claudio Canu, Luciano Battocchio (Alenia Spazio S.p.A., Turin, Italy.), and Mario Cardano (Alenia Spazio S.p.A., Turin, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 41-47 (For primary document see N93-24336 08-12)
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The responsibilities of the APM Center (APMC), which is the engineering support center for the Columbus Attached Laboratory (APM), in the context of Spacelab mission E1 are described. Comparisons are made with analogous Columbus activities. The APMC will be one of the most important European ground facilities for the support of the Columbus Attached laboratory. The APMC will act as the system reference. Additionally, it will support the onboard operations through the engineering and logistics support functions. Finally. the APMC will play a key role for the payload integration, performing both the payload analytical integration and the final acceptance of the payload elements before shipping to the U.S. for the integration on the Logistic Carrier. As the Spacelab mission E1 is a Columbus precursor flight, it will be a unique opportunity to test at least two of the main functions of the APMC, namely the payload integration support and the engineering support. ESA

N93-24345# European Space Agency, Cologne (Germany). Astronauts Div.
SELECTION OF ASTRONAUTS FOR EUROPEAN SPACE MISSIONS **c53**
F. Rossitto and H. Schaarschmidt *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 51-53 (For primary document see N93-24336 08-12)
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A detailed overview of the organizational aspects and activities performed during the selection of the European astronaut candidates is presented. Sixty applications were presented to ESA. The selection phase was divided into two phases: the first phase was dedicated to the psychological assessment and to the professional evaluation; and the second phase was dedicated to the general medical evaluation and to the space specific medical evaluation. ESA

N93-24346# European Space Agency, Cologne (Germany). European Astronauts Div.
THE EUROPEAN ASTRONAUTS TRAINING PROGRAMME **c53**
K. Damian, O. Chiarenza, H. Arend, and P. Nespoli *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 55-61 (For primary document see N93-24336 08-12)
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An overview of the overall training program for European astronauts--who include laboratory specialists and spaceplane specialists-- is given. The laboratory specialists are primarily specialized in the servicing and operation of the Columbus Free Flying Laboratory as well as the Columbus Attached Laboratory and of the other elements of the Space Station Fredom manned base. The Spaceplane specialists are primarily concerned with the operations of the European spaceplane Hermes. The training program covers basic training, specialized training, mission training, and proficiency maintenance. The structure and major contents of the training phases are explained. Basic training provides basic knowledge of space technology and science and basic skills related to future operational tasks. Specialized training provides knowledge and skills related to specific space elements and specific types of missions. Mission training provides the knowledge and skills required to perform a specific mission/increment. An overview of the training facilities which will be used during the training program is also given. ESA

N93-24347# Dornier System G.m.b.H., Friedrichshafen (Germany).
TRAINING FACILITIES AT THE CREW TRAINING COMPLEX **c14**
C. Puetz, A. Torres (European Space Agency, Cologne, Germany.), and F. Demond (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) *In* ESA. Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 63-68 (For primary document see N93-24336 08-12)
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The purpose and concepts of the Crew Training Complex (CTC) facilities at Cologne (Germany, F.R.), which are to be used for the training of the European astronauts for the Columbus and Hermes missions, are addressed. The integrated system training facilities for the Attached Pressurized Module (APM), for the Man Tended Free Flyer (MTFF), and for Hermes are discussed. Facilities for space environment training, such as the Neutral Buoyancy Facility and Space Suit Training Facility, are considered. The computer aided instruction facilities and courses, which will be used to support the practical training of inflight operations, are addressed. The CTC data handling and communication systems, which provide the possibility for the operations personnel to supervise and control all CTC training facilities, are described. ESA

N93-24348# Centre National d'Etudes Spatiales, Paris (France).
FRENCH MIR MISSIONS
Jacques Ratie *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation Of Earth Orbiting Laboratories Jul. 1992 p 71 (For primary document see N93-24336 08-12)
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Joint French-Soviet space programs are considered, particularly in the context of manned space flights. The dates of the missions are given, and their experimental programs are briefly addressed. At the time of printing, two of these missions had been carried out, and the third was being realized. They include, respectively, seven days spent on the Soviet Salyut 7 Space Station in 1982, the Aragatz mission aboard the Mir Space Station in 1985, and the Antares mission planned for 1992 on the Mir Space Station. ESA

N93-24349# Molnia Scientific-Industry Enterprise, Moscow (Russia).
THE EFFECT OF MISSIONS AND PAYLOAD PERFORMANCE ON THE CONFIGURATION OF AN ORBITAL INJECTION SYSTEM DESIGN **c18**
G. E. Lozino-Lozinsky, V. A. Skorodelov, Y. M. Kosinsky, and V. P. Plokhikh (Tsentralni Aerogidrodinamicheskii Inst., Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting

Laboratories Jul. 1992 p 73-77 (For primary document see N93-24336 08-12)
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A discussion of the effect of missions and payload performance on the development of reusable aerospace systems is presented. On the basis of international research, the options of integrity of aerospace vehicle missions performed in an orbit are considered: the effect of interference and debris removal, equipment resolution, and the possibility to modify the equipment when changing the research object as well. Tables showing major missions and objectives of advanced space systems are given and discussed. The distribution of the main missions in the near Earth orbit is shown. Comparison criteria for selection of the most effective reusable aerospace plane concepts are discussed. ESA

N93-24350# Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn (Germany).
MIR '92 PROJECT
H. Binnenbruck, H.-W. Gronert, and C. Nitzschke *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 79-81 Sponsored by BMFT (For primary document see N93-24336 08-12)
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The mission goals, characteristics, organization, and execution of Mir '92, the first joint project of Germany with organizations of the Commonwealth of Independent States (the former Soviet Union) in the field of manned space flight are addressed. Mir '92 was the 8 day mission of a German cosmonaut to the Mir Space station which included a scientific experimental program consisting of 14 experiments dedicated to space medicine. The mission was successfully performed during 17-25 Mar. 1992. The project tasks of Mir '92 were grouped mainly into two parts: crew preparation and operation activities; and the experimental program. The German Mir '92 should be considered an important step towards space station utilization in the upcoming Columbus era. ESA

N93-24351# Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn (Germany).
MIR 1992: SCIENTIFIC PROGRAM AND PAYLOAD
H.-U. Hoffmann, G. Ruyters, and O. Joop *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 83-85 (For primary document see N93-24336 08-12)
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The development of the scientific program of the Mir '92 mission and the program support necessary for its performance are described. The experimental facilities which underwent refurbishment and the selection of the experiments are discussed. Ten experiments in medicine, two in radiation biology, and one in materials science were performed by the German cosmonaut within the 1.5 days in the Soyuz carrier and 5 days aboard the Mir Space Station. The scientific program defined in 1990 covers the following areas: cardiovascular adaptation processes; vestibular adaptation processes; psychological investigation; radiation detection; and materials science. Preliminary results showed the success of the mission. ESA

N93-24352# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Crew Operations Dept.
MIR 1992 OPERATIONS AND CREW TRAINING **c53**
Bolender, R. Ewald, K.-D. Flade, S. Jaehn, R. Lentzen, A. Putzka, A. Schoen, H. Steimle, H. Stromeyer, and W. Wyborny *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 87-89 (For primary document see N93-24336 08-12)
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Preparations and implementation of crew operations and training for the visit of the German science astronaut to the Mir Space Station in Mar. 1992 are highlighted. Apart from the basic training, cosmonaut candidates underwent specialized cosmonaut and science training. A total of 14 experiment objectives with a set of complex experiment equipment were developed by experimenters and German industry, respectively. Experiment processing, equipment, and Mir generic requirements were integrated into training and payload procedures and Mir Space Station resource requirements. ESA

N93-24353# Academy of Sciences, Graz (Austria). Space Research Inst.
THE JOINT AUSTRO-SOVIET SPACE PROJECT AUSTROMIR-91
W. Riedler *In* ESA, Environment Observation and Climate Modelling Through International Space Projects: Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 93-96 (For primary document see N93-24336 08-12)
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The one week visit of the Austrian cosmonaut Franz Viehboeck to the Space Station Mir which began on 2 Oct. 1991 is addessed. Details of the experimental objectives and applications of comosnaut qualifications and of the flight schedule are given. For this flight, out of 34 scientific experiments, 14 were chosen to be performed by the cosmonaut, mainly in the field of life sciences, but also in physics, material science, and remote sensing. All of them performed extremely well and the mission can be considered a full success. Preliminary data reported showed very interresting results. The cooperation with the Soviet scientists and engineers was an extremely cordial and efficient one, a fact which, along with the outstanding performance of the crew, contributed very much to the success of the mission. ESA

N93-24354# Institute of Biomedical Problems, Moscow (USSR).
PHYSIOLOGICAL EXPERIMENTS WITHIN THE PROJECT AUSTROMIR **c52**
I. C. Pestov *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 97-100 (For primary document see N93-24336 08-12)
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The ten medical experiments performed during the joint Soviet-Austrian mission to the orbital Space Station Mir are addressed. Their scientific aims are discussed and their time requirements and experimenters addressed. The aim was to gain new scientific material to assess the influencing factors of a space flight on the human motoric functions, the senses, the blood circulation, higher psychological functions, the volume regulation, the genetic functions, and on an advanced system for the dosimetric control of a space flight. The selected range of tasks covered most topical problems in the field of space medicine and gravitational biology of interest for the general health management both in theory and practice. The results of the research performed improve the picture of the physiological changes which occur during the adaptation of man to weightlessness. This information furthermore allows us to prepare recommendations for a system for the medical supervision of the state of the cosmonaut during the flight. ESA

N93-24355# European Space Agency, Paris (France).
FLIGHT EXPERIENCES ON BOARD SPACE STATION MIR
Franz Viehboeck *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 101-104 (For primary document see N93-24336 08-12)
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A survey of the training in the cosmonaut center 'Yuri Gagarin' near Moscow (U.S.S.R.) and of the preparation for the joint Soviet-Austrian space flight from 2-10 Oct. 1991 is given. The flight in Soyuz-TM 13 with the most important systems, as well as a short description of the Space Station Mir, the life on board the Station with the basic systems, like energy supply, life support, radio, and television are described. The possibilities of exploitation of the Space Station Mir and an outlook to the future is given. ESA

N93-24356# Joanneum Research Centre, Graz (Austria). Applied Systems Technology Inst.

VIDEOMIR: SATELLITE VIDEO CONFERENCING DURING THE AUSTROMIR SPACEFLIGHT **c32**

O. Koudelka and W. Riedler (Technische Univ., Graz, Austria.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 105-110 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)

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A satellite video conferencing system utilized in the DICE (Direct Inter-establishement Communications Experiment) within the Olympus utilization program is discussed. In contrast to conventional systems, up to four sites can be simultaneously connected via satellite. The successful use of this system during the AustroMir space flights, and recently in the German Mir '92 mission is addressed. The flight control center near Moscow (USSR) was connected with several sites on western Europe by satellite for daily press conferences, experimenters' meetings, briefings. and direct links with the Space Station from abroad, providing real time interactive coverage of the event. ESA

N93-24357# Joanneum Research Centre, Graz (Austria). Applied Systems Technology Inst.

TECHNICAL MANAGEMENT AND TEST PROCEDURES FOR AUSTROMIR-1991 **c81**

C. Feichtinger, B. Josseck, V. Berzhatyi (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), T. Batenchuk-Tusko (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), and V. Kozharinov (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 111-115 (For primary document see N93-24336 08-12)

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The coordination of design, development, and testing of hardware to form the AustroMir 91 payload is discussed. An extremely tight time schedule (within 30 months definition, design, development, and testing of more than 10 hardware subsystems had to be completed) made very flexible operation necessary. Five units of each instrument had to be developed and tested: a mockup, a technological unit, a model used for cosmonaut training, a flight unit, and a spare flight unit. All technical specifications and testing procedures had to be coordinated with Soviet experts with respect to the special requirements of Soviet astronautics. Among others, test procedures included acceptance tests in Austria and the Soviet Union, space qualification tests, such as thermal, vacuum, electrical, outgassing, shock and vibration tests, and integration tests in spacecraft simulation units in Moscow (USSR). In spite of the enormous deadline pressure for the preparation of hardware for the first Austro-Soviet manned spaceflight, all systems were qualified on time and taken to the Space Station Mir where they worked without any failure during the whole mission. The payload is presently (Spring 1992) used for continued microgravity investigations onboard in Soviet long term missions and is still working without any problems. ESA

N93-24358# Joanneum Research Centre, Graz (Austria). Applied Systems Technology Inst.

DATAMIR: A PC-BASED COMPUTER SYSTEM FOR APPLICATION AT SPACE STATION MIR **c60**

M. B. Steller (Academy of Sciences, Graz, Austria.), V. Kosharinov (Institute of Biomedical Problems, Moscow, USSR.), S. Kasarinov (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), T. Stockhammer, C. Wagner, A. Wenzel, and P. Williere *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 117-120 (For primary document see N93-24336 08-12)

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The hardware and software design and onboard operation of the common control computer system called DataMir, used in several experiments in the AustroMir project, are discussed. The device is based on IBM compatible industrial computer system. It is the first time, an MS-DOS compatible computer with a link to the on board telemetry system is available on Space Station Mir. A flexible software package supports experiment preparation and execution, including experiment dedicated instructions usually written to the board journal. Serial links enable data exhange with extern units and offers data transfer to the telemetry via standard interfaces. ESA

N93-24359# Austrian Research Center, Seibersdorf.

LOGION: OPERATION OF A LIQUID METAL ION EMITTER MODULE UNDER MICROGRAVITY **c29**

F. G. Ruedenauer, W. Riedler (Academy of Sciences, Graz, Austria.), V. Berzhatyi (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), M. Fehringer, E. Goeschl (Academy of Sciences, Graz, Austria.), C. Kropiunig (Academy of Sciences, Graz, Austria.), L. Neznamova (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), W. Steiger, and K. Torkar (Academy of Sciences, Graz, Austria.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 121-125 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)

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The experiment LOGION, operated during the AustroMir 91 mission, is described. The experiment was the first test ever of a Liquid Metal Ions Source (LMIS) under microgravity conditions. A module containing two indium ion emitters and an integrated ion beam collector was mounted on a hermetic, ion pumped vacumm system. All essential operating parameters were measured in 1 second intervals. The experiment has a total mass of 14.7 kg and a power consumption of 10 W. The emitters alone require only 0.5 microA. First, evaluated flight results showed that operational parameters of the LMIS were within the range observed on ground. Ion beam stability at nominal 10 microA emission was of the order of 5 percent and operating voltages were between 6 and 8 kV. ESA

N93-24360# Technische Univ., Graz (Austria). Inst. for Communications and Wave Propagation.

MIGMAS/A: TEST OF A SCANNING ION MICROSCOPE ONBOARD THE SOVIET SPACE STATION MIR **c19**

W. Riedler, F. G. Ruedenauer (Austrian Research Center, Seibersdorf.), P. Beck (Austrian Research Center, Seibersdorf.), V. Berzhatyi (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), M. Fehringer (Austrian Research Center, Seibersdorf.), R. Finsterbusch, L. Neznamova (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), R. Pammer, F. Puerstl, and W. Steiger (Austrian Research Center, Seibersdorf.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 127-131 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)

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The experiment Migmas-A, the main component of a planned microanalytical analysis station (scanning ion microprobe) operated onboard Mir for investigation of space corrosion is addressed. In its present configuration, it performs the functions of a scanning ion microscope and consists of an ion emitter of the liquid metal field emitter type, a single stage electrostatic ion focusing systems, a quadropole scanning system, and a sample holder. The instrument can display and record high resolution topographic images of material samples. All instrument functions are controlled by an internal microprocessor. Operator interfacing is via menus displayed on the integrated electroluminescent display. During the flight, data were recorded in two 1/2 MB memcards and also were transferred to the central data processor for storage and telemetry. First, flight data are presented, showing excellent focusing and stability properties. ESA

N93-24361# Technische Univ., Vienna (Austria). Inst. for Photogrammetry and Remote Sensing.

REMOTE SENSING EXPERIMENT FEM: A MULTISENSORAL DATASET FOR RADIOMETRIC AND GEOMETRIC ANALYSIS **c43**

R. Kalliany, W. Schneider (Bodenkultur Univ., Vienna, Austria.), K. Eerme (Academy of Sciences of the Estonian SSR, Tartu.), and O. Lebedyev (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 133-138 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)

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The remote sensing experiment which took place during AustroMir, the Austrian Soviet mission to the Space Station Mir in 1991, is described. Details of scientific objectives and instruments are given. This FEM experiment studied the coherence of synergetic data in a multisensoral dataset. During several passes over Austrian territory, either the multispectral camera or a mapping camera, as well as the two spectrometers, were in operation on the station. In Austria, radiometric measurements on ground, photographic surveying flights at different levels, and ascents of meteorologic balloons were carried out simultaneously. In addition, a terrestrial inventory of the phenologic situation was performed. Thus, during the whole mission a multisensoral dataset was recorded, by which various models and methods for radiometric or geometric calibration may be examined and improved. The material obtained is presented, and first statements about the quality are made. ESA

N93-24362# Innsbruck Univ. (Austria). Dept. for Neurology.

EYE-HEAD-ARM COORDINATION AND SPINAL REFLEXES IN WEIGHTLESSNESS **c54**

M. Berger, F. Gerstenbrand, N. Burlatschkova, A. Muigg, L. Grill, G. Holzmueller, I. B. Kozlovskaya (Institute of Biomedical Problems, Moscow, USSR.), M. Borisov (Institute of Biomedical Problems, Moscow, USSR.), B. Babaev (Institute of Biomedical Problems, Moscow, USSR.), and A. Sokolov (Institute of Biomedical Problems, Moscow, USSR.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 139-145 (For primary document see N93-24336 08-12)

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The method and results of the MoniMir experiment, part of the investigation program of the Austrian Soviet spaceflight in Oct. 1991, which investigated the adaptation and readaptation of eye, head, and arm movements, are presented. The movements are highly coordinated under the control of visual, vestibular, and proprioceptive systems. Disturbances on the vestibular and proprioceptive systems caused by weightlessness during spaceflight are responsible for initial movement disorders in space. Visual information is primarily responsible for adaptation of the sensory motor system. Special hardware was developed for the presentation of standardized visual signals and for registration of eye, head, and arm movements. Preprogrammed movements, tracking movements, memorization of movements, and the influence of neck reflexes on arm movements were investigated. Analysis of accuracy, velocity, reproducibility of eye, head, and arm movements, and their changes during and after spaceflight gives further information on the adaptive process of the sensory motor system. ESA

N93-24363# Wien Univ. (Austria). Dept. of Sports and Exercise Physiology.

DEVELOPMENT AND IMPLEMENTATION OF THE MOTOMIR EXPERIMENT ON THE MIR SPACE STATION **c52**

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The MotoMir experiment, developed in the framework of the Austrian-Russian space program, is described. The purpose was to investigate the force-angle velocity relationship of human musculature in and against a predetermined pattern of translatoric movement (concentric and eccentric exercise), and the correlation of the results with neurophysiological data obtained by integrated surface Electromyogram (EMG). A further goal was to answer questions pertaining to muscular fatigue in the zero gravity environment, contrasting force decrease with different EMG parameters during different work modes. The ultimate purpose was to develop concepts which can be applied to the training of astronauts, of athletes, and to the rehabilitation after injuries. Hardware development was based on an existing ground based prototype ergometer with which clinical tests and test with athletes were conducted. Extensive redesign was necessary which resulted in a firmware controlled ergometer with design characteristics allowing the optical use of the zero gravity environment. The following tests were performed: a cyclic leg and arm work in concentric and eccentric work mode depending on different angles and angle velocities; cyclic leg and arm work in three different submaximal intensities, both in eccentric and concentric work mode. Methods, data acquisition, data analysis, and preliminary results are discussed and compared with preflight and postflight investigations. ESA

N93-24364# Innsbruck Univ. (Austria). Dept. of Neurology.

COGIMIR: A STUDY OF COGNITIVE FUNCTIONS IN MICROGRAVITY **c29**

T. Benke, O. Koserenko (Institute of Biomedical Problems, Moscow, USSR.), F. Gerstenbrand, and N. Watson (British Columbia Univ., Vancouver.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation or Earth Orbiting Laboratories Jul. 1992 p 153-155 (For primary document see N93-24336 08-12)

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Nonspecific (attention psychomotor speed) and specific (mental flexibility, time estimation, visuospatial perception, and memory) cognitive functions were measured in a single case study during a six day visit on the Russian orbital complex Mir using computer based psychometric tasks. Reaction times and accuracy scores showed only minor, nonsignificant exchanges between preflight, flight, and postflight measurements. These results suggest that several important cognitive functions, among them complex visuospatial processing skills remain essentially unimpaired during short space visits, provided that physical conditions are stable during the period of microgravity. Computerized psychometric tasks are a highly sensitive and flexible tool to measure behavioral functions in space life science. ESA

N93-24365# Akustische und Kino-Geraete G.m.b.H., Vienna (Austria).

AUDIMIR: DIRECTIONAL HEARING AT MICROGRAVITY **c71**

A. Persterer, M. Berger (Innsbruck Univ., Austria.), C. Koppensteiner (Technische Univ., Graz, Austria.), C. Mueller (Wien Univ., Austria.), M. Nefjodova (Institute of Biomedical Problems, Moscow, USSR.), M. Opitz, and P. Schneider (Wien Univ., Austria.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratotries Jul. 1992 p 157-162 (For primary document see N93-24336 08-12)

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The AudiMir experiment, the first investigation of the auditory system as part of the human orientation system at microgravity, which was performed during the Austromir space mission in Oct. 1991, is described. The project started from the assumption that, in the absence of gravity, orientation by acoustic cues would play a much more important role for a human being than on Earth. The technical realization of the project was based on the presentation of binaurally processed signals over headphones. For the horizontal plane, nonsignificant localization errors were found while a downwards displacement was observed in median plane elevation judgments. The second phase of the experiment for the first time proved the phenomenon that human dynamic orientation can be influenced by audiokinetic stimulation. At microgravity, auditory orientation evidently is of special significance. Further research will have to show whether this discovery will be of any use for future space travel. ESA

N93-24366# Technische Univ., Vienna (Austria). Universitaetsklinik fuer Neurologie.

OPTOVERT: AN AUSTROMIR-1991 EXPERIMENT. ORIENTATIONAL EFFECTS FROM OPTOKINETIC STIMULATION **c53**

C. Mueller, L. Kornilova (Institute of Biomedical Problems, Moscow, USSR.), G. Wiest, and L. Deecke *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 163-167 (For primary document see N93-24336 08-12)

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The Optovert experiment carried out on the third and fifth day of the Austromir 91 space flight is described. The main aim of the experiment was to explore in microgravity the vertical vection illusion which was elicited by means of an optokinetic stimulator system. The cosmonaut was instructed to fixate a central light emitting diode on a spherical screen (60 deg of visual angle in diameter) during up and down motion of a dot pattern. In addition optokinetically induced eye movements were examined as well as the ability for setting the visual vertical correctly. A slight preponderance for downward vection and the occurrence of inverted vection with extreme phase shift during sinusoidal stimulation were considered to be the most striking orientational phenomena in flight. ESA

N93-24367# Technische Univ., Graz (Austria). Physiologisches Inst.

MONITORING OF CARDIOVASCULAR PARAMETERS DURING THE AUSTROMIR SPACE FLIGHT **c52**

M. Moser, E. Gallasch, D. Rafolt, G. Jernej, C. Kemp, E. Maier, T. Kenner, R. Bayevskij (Institute of Biomedical Problems, Moscow, USSR.), I. Funtowa (Institute of Biomedical Problems, Moscow, USSR.), and Y. Avakyan (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 169-174 (For primary document see N93-24336 08-12)

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Two experiments performed during the Austrian-Russian space flight AustroMir in Oct. 1991 to investigate the physiological changes in the circulation under the conditions of microgravity are described: pulstrans, performed during the day, a complex experiment consisting of rest, variations of arm positions, handgrip ergometry and breathing maneuvers; and sleep, developed to observe the cosmonauts circulatory system during the night. The goal of the study was the monitoring of the cosmonauts adaptation to microgravity and the investigation of the physical properties of arm and leg arteries. The observed physiological changes in microgravity compared to upright position range from slightly decreased heat rate, decreased pulse wave velocity in the leg arteries and shifts in the cardiopulmonary coordination to changes in the heat orientation resulting in a marked increase in electrocardiogram amplitude. Arterial pulse transmission shows decreased peripheral resistance in microgravity. Post flight, a decrease of muscular strength and an obvious deconditioning of the circulation takes place, which results in an increase in heart rate above preflight values during day and night and in a shift in pulse-respiration quotient during sleep. ESA

N93-24368# Technische Univ., Graz (Austria). Physiologisches Inst.

THE EFFECT OF MICROGRAVITY ON TREMOR (MICROVIBRATION) **c29**

E. Gallasch, I. B. Kozlovskaya (Institute of Biomedical Problems, Moscow, USSR.), M. Moser, M. Borisov (Institute of Biomedical Problems, Moscow, USSR.), J. Hindinger, A. Konev (Institute of Biomedical Problems, Moscow, USSR.), and T. Kenner *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 175-180 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)

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Some forms of tremor were studied in the Austrian-Soviet orbital flight (AustroMir mission, Oct. 1991). Using two accelerometers fixed at the lower arm and a hand dynamometer, signals were recorded during positional and visual feedback tasks. During the flight tremor at rest (microvibration) shows no oscillations in the 8 to 12 Hz band. Physiological tremor in a postural task was reduced. Tremor in isometric load tests remained unchanged in the microgravity environment. ESA

N93-24369# Technische Univ., Graz (Austria). Working Group for Volume Regulation and Space Medicine.

ALTERED FLUID SHIFT DYNAMICS WITH 6 DAYS IN MICROGRAVITY **c29**

H. G. Hinghofer-Szalkay, E. M. Koenig, G. Sauseng-Fellegger, C. Zambo-Polz, J. Schmied (Labor fuer Messtechnik dr. Hans Stabinger, Graz, Austria.), H. Heimel (Labor fuer Messtechnik dr. Hans Stabinger, Graz, Austria.), V. B. Noskov (Institute of Biomedical Problems, Moscow, USSR.), I. Pestov (Institute of Biomedical Problems, Moscow, USSR.), and A. I. Grigoriev (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 181-186 Sponsored by Bundesministerium fuer Wissenschaft und Forschung and Oesterreichische Akademie der Wissenschaften (For primary document see N93-24336 08-12)

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Intercompartment fluid shifts and hormonal regulation were studied after lower body suction (-15/-30/-35 mm Hg for 15/15/10 min) in the Austrian cosmonaut preflight (supine), inflight (6th day in orbit), and 4th day postflight (supine). Antecubital blood was taken at the beginning (3 min) and after shut down (+2 min) of lower body negative pressure, respectively. Sound Velocity (SV, +/- 0.1 m/s) and temperature (+/- 0.03K) was immediately determined in whole blood and plasma. There was a 1.6 m/s increase in Blood Sound Velocity (BSV) preflight and a 4.0 m/s increase postflight whereas BSV stayed unchanged inflight. Plasma Sound Velocity (PSV) increased 1.2 m/s preflight and 1.7 m/s postflight, whereas PSV did not rise (-0.4 m/s) inflight, suggesting an inflight lack of hemo-concentration with lower body suction. Hormonal changes were partly different inflight as compared to pre and post flight. ESA

N93-24370# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna.

INFLUENCE OF MICROGRAVITY ON IMMUNE SYSTEM AND GENETIC INFORMATION **c52**

H. Tuschl, R. Kovac, W. Klein, E. Ott, Y. I. Voronkov (Institute of Biomedical Problems, Moscow, USSR.), and M. Kaidakow (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 187-191 (For primary document see N93-24336 08-12)

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The effect of spaceflight on lymphocytes of the peripheral blood was investigated in the Austian cosmonaut flying the Austro-Soviet mission 'AustroMir'. Blood was sampled before and after flight, and the following parameters studied: quantities of lymphocytic subsets (T cells, helper cells, suppressor cells, B cells, and natural killer cells); mitogenic stimulation of lymphocytes, DNA (deoxyribonucleic acid) synthesis and expression of Interleukin 2 receptor; and structrural modification of DNA, unscheduled DNA synthesis, and sister chromatid exchanges. Besides reducing the number of natural killer cells, spaceflight caused an impairment of lymphocyte activity and a slight modification of DNA structure. Four weeks after flight, control values were reestablished, indicating efficient repair mechanisms. ESA

N93-24371# Wien Univ. (Austria). Atominst.

DOSIMIR: RADIATION MEASUREMENTS INSIDE THE SOVIET SPACE STATION MIR, FIRST RESULTS **c72**

N. Vana, W. Schoener, M. Fugger, and J. A. Akatov (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 193-197 (For primary document see N93-24336 08-12)

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Two dosemeter packets containing Thermoluminescence Dosemeters (TLD's) and track etch foils were used to measure the absorbed dose and the average Linear Energy Transfer (LET) of the radiation within the Space

Station Mir. One packet was exposed over a period of about 5 months and the other one during the Austria-Soviet manned space program in Oct. 1991. Various types of standard TLD's, Soviet Al2O3 TLD's and Austrian labor made LiF single crystals were used. The change in the peak height ratio, phototransfered TL and glow peak deconvolution were used to measure the absorbed dose and the average LET of the radiation within the space station Mir. The first results taken by TLD's reveal a radiation dose of 1.6 mGy and an average LET of 7 keV/micrometers in tissue caused by the radiation field within the space station Mir during the mission. ESA

N93-24372# Bristol Univ. (England). Physics Lab.
GRAVITY-RELATED PHENOMENA IN MATERIALS SCIENCE **c29**
D. T. J. Hurle *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 201-206 (For primary document see N93-24336 08-12)
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A personal opinion of the scope and role of microgravity research in materials science together with its industrial relevance and potential for application is presented. The meaning of microgravity is discussed and the parameters which specify a microgravity environment are considered: the magnitudes of the spectral components of the residual acceleration and the duration for which the microgravity level can be maintained. Requirements for an effective research program are discussed. Research topics suitable for microgravity are discussed. These include things which can not be done on Earth. Measurements of the coefficients in the following are considered suitable: Soret diffusion, ordinary Fickman diffusion, thermal conductivity, Dufour coefficient, and electrotransport coefficients. The range of materials would include metal alloys, molten oxides and salts, organic mixtures etc. Measurements in the vicinity of the critical point would be important in some systems. The second general area of research selected is the model experiment to determine the physics or physical chemistry involved in a process, for example directional solidification of monotectonics or segregation in crystal growth were the competing effects of natural convection or sedimentation on Earth so complicate the behavior that its fundamentals can not be unraveled. ESA

N93-24373# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Biophysics Div.
LIFE IN AND FROM SPACE **c55**
G. Horneck *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 207-210 (For primary document see N93-24336 08-12)
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Certain questions are addressed with the aim of investigating whether life is an integral part of cosmic evolution relevant to any celestial body given enough time and the right environmental and statistic conditions. The general principles of life and the environmental requirements and boundary conditions of life are discussed. The criteria for habitability of a celestial body are also discussed together with the chances of distribution of life between different celestial bodies. ESA

N93-24374# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Microgravity User Support Center.
THE MICROGRAVITY USER SUPPORT CENTER (MUSC) **c14**
K. Wittmann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 213-216 (For primary document see N93-24336 08-12)
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The Microgravity User Support Center (MUSC), located in Cologne (Germany, F.R.), which offers support for preparation, operation, and evaluation of microgravity experiments, is addressed. Both microgravity subdisciplines, materials and life sciences are covered. MUSC will evolve through the upcoming missions in Spacelab, Eureca, Mir and Texus into a facility responsible center for the Space Station era. ESA

N93-24375# Microgravity Advanced Research and Support Center, Naples (Italy).
MICROGRAVITY ADVANCED RESEARCH AND SUPPORT (MARS) CENTER UPDATE **c14**
R. Monti and C. Mirra *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 217-220 (For primary document see N93-24336 08-12)
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The Microgravity Advanced Research and Support (MARS) Center, which was set up as a reference for the national and international microgravity user community offering within its structure a user support center with the objective to stimulate, ease, and support the conception, development, preparation, and execution of experiments in weightlessness, is addressed. A concise survey of what was performed in one year at the MARS Center for the development of a utilization center for Columbus exploitation in Italy is given. Major events are reviewed with classification of them with respect to the user support tasks that the center is intended to provide in its steady state conditions. ESA

N93-24376# Microgravity Advanced Research and Support Center, Naples (Italy).
TELESCIENCE OPPORTUNITIES IN THE PRECURSOR FLIGHTS **c17**
R. Fortezza and K. Wittmann (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 221-226 (For primary document see N93-24336 08-12)
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A telescience program conceived by the Microgravity Advanced Research and Support (MARS) Center and the Microgravity User Support Center (MUSC) to establish a preliminary infrastructure for decentralized facility operations and telescience for the Columbus precursor flights in spacelab and Eureca is addressed. The required activities and the equipment/tools needed for an efficient implementation of the telescience operative mode are discussed. This operational mode will be developed for a selected number of facilities and experiments, assuming the implementation of an adequate network of User Home Basis (UHB) and User Support and Operation Centers (USOC). Futhermore the establishment of an adequate interface between the user ground infrastructure and the mission control functions will play a major role. The precursor flights provide the opportunity to assess the feasibility of this concept for the Columbus era and to demonstrate the effectiveness of the provided services with respect to the user needs. ESA

N93-24377# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).
COMPASS: A COMPUTERIZED PAYLOAD OPERATIONS SUPPORT SYSTEM FOR COLUMBUS **c18**
D. Heyland, A. Kellner (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany.), and R. Timm (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 227-233 (For primary document see N93-24336 08-12)
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The activities relating to the prototype development of a Computerized Payload Operations Support System (COMPASS) for the Columbus Space Station are described. The differences between Spacelab and Columbus space segments experimentation capabilities and payload operations are outlined and the steps of the requirements analysis for setting up a payload diagnosis, integration/reconfiguration support, and reactive science support are described. The BLUME/BIOMAUS facility turned out to be the best COMPASS test candidate. Blume is a biology payload designed to fly as part of the NASA Get Away Special program. Software technologies and the architectural concept for COMPASS are shown. The COMPASS prototype was installed in the environment of the ESTEC crew workstation testbed and can be demonstrated there. ESA

N93-24378# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).

THE REFINED DECENTRALIZED CONCEPT AND DEVELOPMENT SUPPORT **c14**

H. T. Blume, T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), H. Duwe, N. Eilersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. Gaida, M. Herten, T.-H. Iversen (Trondheim Univ., Norway.), and C. Jungius et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 235-239 (For primary document see N93-24336 08-12)

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After the technical feasibility of the decentralized user support was demonstrated, this study phase elaborated on questions with respect to the sharing of responsibilities and how to operate the different types of payloads. After working out an appropriate classification for payloads it is shown that a clear scheme about the distribution of responsibilities during the various phases of an experiment was found and that the payload operation can be performed in the vicinity of the researcher. The aspect of development support was picked up by the user support to minimize the development process. A list of the tasks to be performed in support of the development of experiments was compiled with a detailed description for each payload class. ESA

N93-24379# Trondheim Univ. (Norway).

THE USO-CONCEPT APPLIED TO A BIOLOGICAL MODEL EXPERIMENT **c51**

T.-H. Iversen, E. B. Skagen, C. Baggerud, T. Beisvaag, O. S. Rasmussen (Aarhus Univ., Denmark.), T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), H. T. Blume (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), and H. Duwe (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 241-244 (For primary document see N93-24336 08-12)

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For the European User Support Organisation (USO) definition study, the payload flow of a plant bology model experiment planned for the Columbus Attached Laboratory (CAL), is described. The implementation of the user support functions from the initial scientific idea, through the operation in space, to the completion of the experiment on the ground and publication of the results, is described. The plant material consists of cell wall free plant cells (protoplasts) and their regeneration processes via cell cultures to new plants. Results obtained from preliminary work using clinostats on ground and under microgravity conditions onboard Biokosmos 9 and IML 1 on the Space Shuttle are included. Interpretation problems arising as a result of the hardware used and technical constraints are discussed within the USO concept. ESA

N93-24380# Microgravity Advanced Research and Support Center, Naples (Italy).

USER SUPPORT FOR THE COLUMBUS PRECURSOR MISSIONS **c14**

C. Mirra, T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), H. T. Blume (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo, H. Duwe (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), N. Eilersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. Gaida (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. Herten, and T.-H. Iversen (Trondheim Univ., Norway.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 245-249 (For primary document see N93-24336 08-12)

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Based on the user Suport Organization (USO) definition concept, means by which user support for the precursor missions could be implemented are described. A survey of the facilities to be included in the Spacelab E1 and the Eureca 2 missions was performed. An overview of the national user support activities in Europe is given. It is assumed that this infrastructure can be applied for precursor mission support, as well. On the basis of the results of these two surveys, an exercise was executed to map the various support functions to be performed by the available utilization centers. In this work, the Facility Responsible Center and Experiment Support Center status was assigned to various centers. The results of the mapping exercise are presented. ESA

N93-24381# Danish Aerospace Medical Center of Research, Copenhagen.

DEFINITION OF A EUROPEAN PROMOTION CONCEPT

T. A. E. Andersen, H. T. Blume (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), H. Duwe (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), N. Eilersen, M. Gaida (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. Herten (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), T.-H. Iversen, and C. Jungius (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 251-255 (For primary document see N93-24336 08-12)

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A marketing strategy for the services offered by the Columbus program is presented. The marketing goals, activities and means, and the procedures for monitoring and control are defined within the context of a first tentative marketing plan for Columbus utilization. The proposed organizational structure, based on national user support organizations within Europe, allows as far as possible for a clear coupling of the organization to the market segment. ESA

N93-24382# Danish Aerospace Medical Center of Research, Copenhagen.

TRAINING CONCEPT FOR CREW, END USER, AND GROUND CENTRE PERSONNEL IN THE COLUMBUS UTILISATION PROGRAMME **c53**

T. A. E. Andersen, H. T. Blume (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), H. Duwe (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), N. Eilersen, M. Gaida (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. Herten (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), T.-H. Iversen, and C. Jungius (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 257-262 (For primary document see N93-24336 08-12)

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Training concepts developed by the European User Support Organisation (USO) definition team for crew, experimenters and for the user support personnel of the Utilisation Centers (UC), are addressed. The concept concentrates on experiment operation for the Attached Laboratory and the Free Flying Laboratory. Implementation of the training concept will depend on the trainees: laboratory specialists, new or experienced users and technical or administrative UC personel. The concepts, however, are based on the same fundamental principles: the training and lessons will be given directly by personnel who have expert knowledge and responsibility during the increment operation. The concept will not only minimize the educational period, but the complexity of the training will be restricted to the real

knowledge required by the trainees. The organization of the training will also minimize the number and duration of travels. ESA

N93-24383# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).
INFORMATION HANDLING AS TASK LAYER OF COLUMBUS USER SUPPORT **c82**
H. Duwe, P. Vielcanet (CISI Ingenierie, Toulouse, France.), T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), H. T. Blume, M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), N. Eilersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. Gaida, M. Herten, and T.-H. Iversen (Trondheim Univ., Norway.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 263-268 (For primary document see N93-24336 08-12)
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Research performed in the Columbus environment will make continuous use of sophisticated computer equipment. 'Information handling' which is defined in the sense of an overall computer utilization perspective for user support, is considered. Information handling has to be provided for all building blocks of the foreseen European Utilisation Centers (UC's). For each building block an accompanying service concept has to be elaborated during the frame specification for a European utilization computer network. The specification effort shall lead to a clear and evolving design of modular computer based subsystems (e.g. for planning, commanding). Commonalities between different services shall improve development of flexible standard tools. The computer hardware configuration, the system and application software, the information processing personnel, etc., have to be organized in distributed entities forming a highly efficient performance network, where adequate coordination is mandatory. To ensure this objective the presented concept proposes and outlines four modern modeling approaches to capture the significant contour of distributed and cooperative systems for information processing. An organization, an activity/function, an information and a technology model shall be elaborated. The integration of these different viewpoints shall provide a template for the federation of distributed systems. ESA

N93-24384# National Aerospace Lab., Emmeloord (Netherlands).
PAYLOAD OPERATIONS
B. Visser, T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), H. T. Blume (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. Brouwer, L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), H. Duwe (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), N. Eilersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. Gaida (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. Herten, and T.-H. Iversen (Trondheim Univ., Norway.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 269-272 (For primary document see N93-24336 08-12)
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To allow implementation of efficient user support for experiment operation preparation, a method for describing an experiment during the operational phase is required. The application of a well known method, based upon states and transitions, for this purpose is described. The method is concluded to be promising and expected to be useful with respect to experiment resource estimation and real time telecommand checking. ESA

N93-24385# Naples Univ. (Italy). Inst. of Aerodynamics.
FLUID SCIENCE USERS REQUIREMENTS **c34**
R. Monti and L. Carotenuto (Microgravity Advanced Research and Support Center, Naples, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 275-280 (For primary document see N93-24336 08-12)
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The microgravity fluid science concerns all the studies aimed at the understanding of influence of gravity levels in the properties and hydrodynamics of fluids or to exploit particular fluid behaviors occurring under reduced gravity levels to study new or weak phenomena usually masked by gravity. Classic fluid science experiment areas are discussed: thermodynamics; fluid mechanics and fluid chemistry. It is concluded that the scenario of fluid science experimentation is evolving, in the research areas in the gravitational level requirements and in the operative requirements. User requirements are evolving in view of a number of facts: extension of fluid science activities into nonconventional areas; increasing demand of characterization of residual accelerations; and change of the operational scenario foreseen for Columbus. It is suggested that all evolving requirements should be taken into account for the identification of fluid science facilities and of their operating mode. ESA

N93-24386# Deutsche Sporthochschule, Cologne (Germany). Physiologisches Inst.
COLUMBUS PAYLOAD REQUIREMENTS IN HUMAN PHYSIOLOGY **c52**
Juergen Stegemann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 281-283 (For primary document see N93-24336 08-12)
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The phase A study report provided by scientists of different fields of physiology who were asked to provide a 'science study' for the Columbus payload requirements, is presented. The report concerns the Anthrolab, a laboratory that covers all presently known research challenges in the area. Anthrolab is more or less an improvement of the Anthrorack to be flown on the German Spacelab mission D-2 and on the Columbus precursor flight E-1. Beside the present Anthropack design Antrolab also will provide subelements for vestibular, neurophysiological, and biomechanical research. The main subelements and major devices of Anthrolab are listed: respiratory monitoring system, ultrasound monitoring system, liquid monitoring and processing system, neuromuscular laboratory, stimulation devices. Some scientific areas which might be investigated using this equipment are depicted. ESA

N93-24387# Padua Univ. (Italy). Center of Studies and Activities for Space.
EUROPEAN SPACE SCIENCE AND SPACE STATION FREEDOM **c19**
P. L. Bernacca *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 285-288 (For primary document see N93-24336 08-12)
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Six instruments for space sciences are presented as potential external payloads, which need accommodation on the Space Station Freedom (SSF) truss or on the Columbus Attached Laboratory (CAL) by means of a terrace or balcony: SUN (an interferometer with a baseline of 2m); ORFEUS (a stellar spectrometer); LOBSTER (a Large Angle Observatory for Bursts Supernova and Transient Event Researh); GAUSS (Galactic Ultrawide Schmidt System to feed a Schmidt camera); UTEF (Ultraviolet Telescope Facility); DUSTWATCH (a facility for exposing passive substrates and active particle detectors to the space environment). Three of them (ORFEUS, SUN, UTEF) require pointing platforms with 20 inch stability and capability of rotation around the line of sight. Two (GAUSS, LOBSTER) are satisfied with a pointing stability of 1 foot. For DUSTWATCH, SSF may be an acceptable platform. Two contamination aspects are of concern: degradation of ultraviolet (UV) coatings due to molecular deposition and increased background radiation due to local molecular and particulate scattaring and emission. The scientific objectives address forefront problems in a wide energy range from gamma rays, through X-rays and the extreme UV, down to the far UV and the UV. One instrument (SUN) is the European forerunner for UV imaging interferometry from space. ESA

N93-24388# European Space Agency, Paris (France).
ATTACHED PAYLOAD ISSUES **c18**
G. P. Haskell *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 289-290 (For primary

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The capability of Space Station Freedom to accommodate attached payloads is outlined. There is accommodation for attached payloads on the truss structure, Japanese Experiment Module (JEM) and the Columbus Attached Laboratory (CAL). All routine in orbit operations such as installation and desinstallation of attached payloads or their platforms will be carried out by robotic methods. The following are discussed: orbit and viewing constraints; contamination; lead times for payloads; European access to the truss sites and JEM-EF (Exposure Facility); and support for attached payload users in Europe. ESA

N93-24389# Italian Space Agency, Rome.
THE STRATEGIC ROLE OF AUTOMATION AND ROBOTICS FOR COLUMBUS UTILIZATION **c63**
Simonetta DiPippo *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 291-294 (For primary document see N93-24336 08-12)
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The advantages to be obtained from implementing a robotic capability on the Columbus Attached Laboratory are outlined. Starting with the Columbus needs, the Bioscreening with Robotic (BioRob) experiment is summarized. For what concerns the robotic system, in particular, the baseline configuration foresees a manipulation system (SPIDER) and a robot controller. These are described. It is concluded that the SPIDER manipulation system, and in particular its single arm, fulfills all the requirements of the robotic arm needed for BioRob and, with its full capability, for Columbus. ESA

N93-24390# Tecnospazio S.p.A., Milan (Italy).
COLUMBUS AUTOMATION TESTBED: A TOOL FOR USERS **c14**
G. Colombina, C. Jones (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), and W. dePeuter (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 295-299 (For primary document see N93-24336 08-12)
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A Columbus Automation Testbed (CAT), developed to evaluate the benefits of Automation and Robotics (A and R) for payload operations and for familiarizing potential users, payload engineers and operators with A and R, is described. In particular CAT will permit: the benefits which the principle investigator will get from A and R utilization to be understood; the best task allocation between crew dedicated mechanisms and robots; assessment and validation of A and R interfaced within a Columbus environment; assessment and validation of A and R generational procedures and utilization scenarios; evaluation of potential growth for internal A and R. With respect to this last point, it has to be highlighted that CAT will be upgraded to further improve the fidelity and to integrate new experiments. ESA

N93-24391# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Flight Systems Dynamics Inst.
THE SPACE ROBOT TECHNOLOGY EXPERIMENT (ROTEX) ON SPACELAB-MISSION D2 **c63**
G. Hirzinger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 301-309 (For primary document see N93-24336 08-12)
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The overall configuration, sensory components, actuators and telerobotic concept of the ROTEX experiment, which is to fly on the Spacelab Mission D2 in Jan. 93, are addressed. ROTEX provides a small six axis robot within a rack of Spacelab. Its multisensory gripper containing stiff and compliant wrist force torque sensors, tactile sensors, 9 laser range finders and a pair of tiny stereo cameras is the basis of the robot's local sensor based autonomy. The robot is supposed to perform different rotortype tasks like assembly of a grid structure, connecting/disconnecting electrical plugs (bajonet closure), and capturing a free floating object. With these prototype tasks ROTEX is supposed to prepare the most typical applications for the future (assembly of structures, internal and external servicing, satellite retrieval and repair etc.). Depending on joint fraction models observed on board under zero G, the joint controllers are as well adaptable from ground as the external feedback loops using self learning techniques. The robot is operated in a number of different modes, e.g., executing preprogrammed paths teleoperated by astronauts, teleoperated from ground using advanced predictive stereographics for delay compensation, ground reprogramming and telesensorprogramming based on a complete 'virtual' environment including sensory simulation. ESA

N93-24392# Italian Space Agency, Rome.
ITALIAN PAYLOAD DEVELOPMENT STATUS FOR COLUMBUS
A. Loria and C. Mirra (Microgravity Advanced Research and Support Center, Naples, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 311-313 (For primary document see N93-24336 08-12)
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Starting from a brief historical background, ideas and concepts for Italian payloads development for Columbus are reported. Ongoing efforts on precursor missions proposals analysis and future activities are also briefly depicted. These include a microgravity program to define the first steps necessary for future payload building. The following facilities are outlined: boiling; two phase; combustion; fluidized bed. The expectation for the future is to continue in the development of the instruments and facilities depicted in order to be able to allocate part of them for the beginning of the Columbus space station operations. ESA

N93-24393# Bayreuth Univ. (Germany). Inst. of Physics.
THERMAL CONVECTION IN ROTATING SYSTEMS AND THE BAND STRUCTURE OF THE MAJOR PLANETS **c91**
F. H. Busse *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 317-324 (For primary document see N93-24336 08-12)
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The rich variety of nonlinear dynamical phenomena in a most simple configuration of convection driven by centrifugal buoyancy on the one hand, and its far reaching potential in explaining many of the remarkably regular features observed in the major planets on the other hand, are demonstrated. The problem of thermal convection driven by centrifugal buoyancy in rotating cylinders and spherical shells is reviewed and a number of unusual dynamic features are pointed out. In the case of the cylindrical annulus the transition to asymmetric convection gives rise to the generation of strong mean zonal flows which appear to be related to the observed zonal jets in the atmospheres of Jupiter and Saturn. Because many phenomena such as period doubling sequences and transitions to chaos can be described on the basis of a spatially two dimensional analysis, the convection problem also serves as a particularly attractive system for the study of nonlinear dynamics. Through numerical simulations and experimental studies the close correspondence between convection in rotating spheres and cylinders can be established. ESA

N93-24394*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
STARDUST: STUDIES IN MICROGRAVITY OF CONDENSATION AND AGGLOMERATION OF COSMIC DUST ANALOGUE **c90**
F. Ferguson (Virginia Univ., Charlottesville.), L. U. Lilleleht (Virginia Univ., Charlottesville.), J. Nuth, J. R. Stephens (Matrix Corp., Santa Fe, NM.), E. Bussoletti (Istituto Universitario Navale, Naples, Italy.), L. Carotenuto (Microgravity Advanced Research and Support Center, Naples, Italy.), L. Colangeli (Cassino Univ., Italy.), P. DellAversana (Microgravity Advanced Research and Support Center, Naples, Italy.), F. Mele (Microgravity Advanced Research and Support Center, Naples, Italy.), and V. Mennella (Osservatorio Astronomico, Capodimonte, Naples, Italy.) et al *In* ESA, Environment

Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 325-329 Sponsored in part by Italian Space Agency (For primary document see N93-24336 08-12)
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A short description of the program Stardust whose goal is to study the formation and properties of high temperature particles and gases, including silicate and carbonaceous materials, that are of interest in astrophysics and planetary science, is given. The international program was carried out in microgravity conditions in parabolic flight. A description of the laboratory equipment, conceived to perform experimental tests in reduced gravity conditions, and which is based on the gas evaporation technique, is given. The gas evaporation technique utilizes one or more heated crucible to vaporize solids materials (SiO, Mg) in a low pressure of inert or reactive gas inside of a vacuum bell jar. The vapor pressures of the materials are controlled by the temperature of the crucibles. The temperature and pressure of inert gas are also controlled. By varying the vapor pressure relative to the gas temperature and pressure, the conditions for substantial grain condensation can be controlled and grain formation measured using light scattering techniques. Thus the partial pressure for grain condensation, can be measured as a function of temperature. The gas evaporation technique has the advantage that complex chemical systems can be studied by using multiple crucibles each containing solid source material. Experimental results and future trends are addressed. ESA

N93-24395# Genoa Univ. (Italy).
CONTROL OF THE CONCENTRATION GRADIENT DURING CRYSTAL GROWTH FROM SOLUTION **c76**
F. Bedarida, G. A. DallAglio, A. C. Hernandes (Sao Paulo Univ., Brazil.), E. Piano, and C. Pontiggia *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 331-334 (For primary document see N93-24336 08-12)
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The growth of a HgI2 crystal from solution is studied in coherent light with a new optical schema. A laser beam crosses the solution where the crystal is growing. The beam is there diffracted by a slot 25 micrometers wide and the diffraction pattern is analyzed. It moves according to the gradient of the concentration. By analyzing the pattern movements one can get information on the phenomena occurring inside the solution. A near discontinuity in the concentration plot is always present at some distance from the growing crystal surface. This is the signal of an 'anomaly' in the concentration behavior. This method can be used to study crystal growth in microgravity. ESA

N93-24396# Officine Galileo S.p.A., Florence (Italy).
THE SURFACE PLASMON SPECTROSCOPY APPLICATIONS IN MICROGRAVITY: THE MEASUREMENT THEORY AND PRELIMINARY EXPERIMENTAL LAYOUT **c29**
G. Margheri, M. Tacconi, and P. G. Falciani *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 335-338 (For primary document see N93-24336 08-12)
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Results obtained with two experimental set ups able in principle to monitor deposition processes (organic films growth, semiconductor growth etc.) with the usual environment restrictions for microgravity applications, both of them using the principle of surface plasmon spectroscopy and the Krestchmann coupling configuration, are reported. The calibration measurements on a silver film (having the functions of deposition substrate) are reported, using for comparison two different wavelengths, and data thickness and refractive index are evaluated with a least squares fitting algorithm. ESA

N93-24397# Academy of Sciences of the Latvian SSR, Riga. Physics Inst.
A THERMAL TYPE PROBE FOR LOW VELOCITY MEASUREMENTS **c19**
L. Gorbunov and V. Kolevzon *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 339-340 (For primary document see N93-24336 08-12)
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The problem of low velocity measurements in experiments on free and forced convective flows is considered. For solving this problem the velocity probe is proposed. The principle of its operation is based on temperature monitoring of two metal joints heated electrically. The probe can work either in regime of constant temperature loading or in time dependent regime which is called 'thermal shock'. The dependance of Nusselt number from Peclet number refered to the first regime is most likely to the thermoanemometer one. The unsteady regime is determined by dependance of characteristic time versus the Reynolds number. Both of these regimes may be used for velocity measurements. ESA

N93-24398# Nagoya Univ. (Japan). Research Inst. of Environmental Medicine.
TELESCIENCE TESTBEDDING FOR PHYSIOLOGICAL EXPERIMENTS UNDER HYPOBARIC HYPOXIC CONDITIONS **c52**
Satoru Watanabe, Masamichi Yamashita (Tokyo Univ., Sagamihara, Japan.), Takatoshi Shoji (Kawasaki Heavy Industries Ltd., Gifu, Japan.), Hiroyuki Suzuki, Sokichi Sakuragi (Aichi Univ. of Education, Japan.), Shigeo Mori, Yoshirou Wada, and Mitsuhiro Koeda (Chukyo Univ., Toyota, Japan.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 341-346 (For primary document see N93-24336 08-12)
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A testbed experiment is presented which explores the effect of telescience utilization in an experiment to test changes in work efficency under severe conditions. These severe conditions are provided through the hydrobaric and hypoxic environments of a decompression chamber. A psychological examination was performed using the Kraeplin test and scoring on a television game. The Continent Negative Variation (CNV) and alpha blocking activation at low atmospheric pressure was also examined. The last one was a variation of heart rate during exercise in such low pressure. Timelining of these experiments was optimized to reduce the total elapsed time. Two principal investigators share time and two operators who were subjects of the experiments at the same time. Response of CNV was preprocessed onboard to compress raw data for downlink. Performance to play a TV game and to conduct arithmetic calculation of the Kraepelin, test was investigated to evaluate the thinking power of the operators during the experiment run. It was learned that flexible management on timeline and crew care enhances scientific achievements in a great amount at the telescience situation. ESA

N93-24399# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Aerospace Medicine Inst.
CARDIOVASCULAR STRESS TEST WITH NON-INVASIVE TECHNIQUES **c52**
F. Baisch, L. Beck, I. Retat (Erno Raumfahrttechnik G.m.b.H., Bremen, Germany.), and M. Soelter (Erno Raumfahrttechnik G.m.b.H., Bremen, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 347-352 (For primary document see N93-24336 08-12)
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The Anthrorack Lower Body Negative Pressure Device (LBNPD) and multiple non invasive measurement devices are presented. These can be used for cardiovascular research, diagnostics, and training in space and on ground. The LBNPD can be operated as a standalone instrument. Computer operation provides, however, more flexibility. In both cases, safety measures prevent the overstraining of the test subjects. Early detection and prevention of cardiovascular degradation is a main commitment of health care in space and on ground. It ethically requires non invasive diagnosis. Combination of noninvasive methods with the LBNP stress yields a valid scenario. On line analysis of non invasively obtained biosignals must rely, due to the large amount of produced data, on a powerful signal

analysis and validation system. The main component of such a scenario could be a multiprocessor computer system that efficiently reduces the data amount while increasing the medical information content. ESA

N93-24400# Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands). Product Centre.

A BODY MASS MEASUREMENT DEVICE BASED ON THE OSCILLATION PRINCIPLE **c52**

J. F. F. Klinkhamer and F. Brechignac (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 353-357 (For primary document see N93-24336 08-12)

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The study and development of a Body Mass Measurement Device (BMD) whose technical objectives aim at a repeatability of measurement better than +/- 100 grams with a compact instrument easy to operate, are reported. Assessment of the error sources by analysis and simulations resulted in the selection of the oscillation principle as the most promising concept to fulfill the requirements. Based on this choice, a breadboard was constructed which includes a parallel leaf spring mechanism combining two functions: spring elasticity and parallel guiding. With the further provision of a test set up designed to simulate microgravity in two horizontal dimensions, an experimental program was undertaken in order to gain a better understanding of the various error contributions, and to derive countermeasures for further improvement. The results presented strongly suggest that a body posture more compressed than the standing one will yield better performance; further meeting the requirements. ESA

N93-24401# Ruhr Univ., Bochum (Germany). Comparative Endocrinology Research Section.

CEBAS-AQUARACK: AN ARTIFICIAL AQUATIC ANIMAL PLANT ECOSYSTEM AS A TOOL FOR BASIC RESEARCH IN THE COLUMBUS SPACE STATION **c51**

V. Bluem, K. Kreuzberg (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), and E. Stretzke *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 359-364 Sponsored by Ministry of Science and Research (For primary document see N93-24336 08-12)

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The CEBAS (Closed Equilibrated Biological Aquatic System) Aquarack project, including its scientific frame program is primarily dedicated to basic research to study the influence of space conditions on aquatic animals and plants in long term multigeneration experiments. It also represents an extensively self maintaining closed artificial aquatic ecosystem for fish and higher water plants or microalgae and may have potential application for producing food in space. CEBAS is already operative in two versions of laboratory models in the frame of an international basic research program. It is a German option for the Columbus space station. CEBAS consists of a zoological component (animal tank including water recycling system), a botanical component (higher water plant compartment of microalgal bioreactor) and an electronical component (process control system). The basic concept and the organization of the scientific frame program are explained and latest examples of results of the current zoological research with special respect to reproductive biology are presented. The problems of intensive aquaculture systems, especially combined ones, disposed for the utilization in lunar or planetary bases are discussed. ESA

N93-24402# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

JAPANESE TREEFROG EXPERIMENT ONBOARD THE SPACE STATION MIR **c51**

Masamichi Yamashita and Akemi Izumi-Kurotani *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 365-369 (For primary document see N93-24336 08-12)

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An experiment investigating the postures and behavior of Japanese treefrogs Hyala japonica during 8 days on the Mir Space Station is presented. The frogs floated in a free volume with four legs stretched and body bent backward. Some of behaviors shown by the frogs are never or rarely observed on ground. Many of the frogs bent their neck severely backward when they perched in a surface, and walked backward some time. Degree of adaptation to space environment, in terms of behaviors, was evaluated by repeating the experiment on a different day. Number of failure at landing on a surface from free floating in a space was found to decrease at the later day in orbit. Readaptation process were analyzed at their recovery to ground. Changes of bone, muscle, inner ear, and hormones were investigated in the recovered frogs. ESA

N93-24403# Paris VI Univ. (France).

GRAVITY AND ROOT MORPHOGENESIS **c51**

G. Perbal and D. Driss-Ecole *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 371-377 Sponsored by CNES (For primary document see N93-24336 08-12)

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Results of experiments to investigate the effects of gravity on root morphogenesis are presented and discussed. When a seedling root is placed in the horizontal position its extremity bends in order to recover its initial orientation with respect to gravity. The curvature is due to a differential growth in the lower and upper sides of this organ. In microgravity, cell elongation occurred closer to the root meristem than in the 1 G centrifuge and the mitotic index was greater. In microgravity, a relaxation of the cytoskeleton of statocytes was also observed. It is proposed that on the ground minuscule forces are exerted by the statoliths on the periphery of the statocytes and that these forces lead to a symmetrical signal responsible for straight growth. When the root is placed in the horizontal position, on the contrary, the pressure of the statoliths creates an asymmetrical message which provokes the gravitropic curvature. ESA

N93-24404# Nottingham Univ. (England). Dept. of Life Science.

DEVELOPMENT OF ARABIDOPSIS THALIANA GROWN UNDER MICROGRAVITY CONDITIONS **c51**

L. G. Briarty and E. P. Maher (Open Univ., Scotland.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 379-384 Sponsored by United Kingdom Science and Engineering Research Council and Nottingham Univ. National Westminster Bank Research Fund (For primary document see N93-24336 08-12)

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

An experiment to determine the effects of microgravity conditions on the early growth of Ariabidopsis thaliana wild-type and aux-1 mutant seedlings was developed and flown in the biorack on the IML-1 mission of Spacelab in January 1992. The experiment was carried out successfully and seedlings fixed at four stages of germination were returned to Earth; early analysis shows little difference in growth rates in microgravity and 1 G of the roots and hypocotyls of the plants, though hypocotyl hook formation appears altered in microgravity. Further studies of cell and tissue structure in the various plant organs are under way. ESA

N93-24405# Centre National de la Recherche Scientifique, Orleans (France). Centre de Biophysique Moleculaire.

EXOBIOLOGY AND TERRESTRIAL LIFE **c55**

Andre Brack *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 387-391 (For primary document see N93-24336 08-12)

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Terrestrial life can be schematically described as organic molecules organized in liquid water. According to Oparin's hypothesis, organic building blocks required for early life were produced from simple organic molecules formed in a primitive reducing atmosphere. Some precursors of biomolecules

have been obtained in the laboratory. Geochemists favor now a less reducing atmosphere dominated by carboin dioxide. In such an atmosphere, very few building blocks are formed. Import of extraterrestrial organic molecules may represent an alternative supply. Experimental support for such an alternative scenario is examined in comets, meteorites and micrometeorites. In contrast to the classical scenario, a chemoautotrophic origin of life is discussed. Finally, interesting information related to early terrestrial life may be gained from Mars exploration. ESA

N93-24406# Ruhr Univ., Bochum (Germany). Comparative Endocrinology Research Station.
ECOSYSTEMS ON EARTH AND IN SPACE (THE POSSIBLE UTILIZATION OF ARTIFICIAL ECOSYSTEMS FOR SPACE LIFE SUPPORT SYSTEMS) **c54**
V. Bluem *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 393-398 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The possibilities and constraints of the utilization of biogenerative systems for space life support systems are discussed and examples of past and current scientific activities in this field are demonstrated. On Earth organism are influenced by two types of environmental factors: abiotic (e.g., temperature, medium salinity) and biotic ones (e.g., food, predators). During evolution organisms had to avoid or to adapt to given or changing factors and they are linked in different levels into regenerative cycles for oxygen, nitrogen and water which guarantee the maintenance of life together with the essential solar energy. In space the environmental factors are lethal for living beings and for spaceflight life support systems are an essential precondition. Until today these are 'alimentary', i.e., all food, water and oxygen has to be brought into and the wastes have to be removed form the protective environment. ESA

N93-22621*# National Aeronautics and Space Administration, Washington, DC.
REMARKS BY NASA ADMINISTRATOR DANIEL S. GOLDIN
Daniel S. Goldin *In its* Space Station Freedom Utilization Conference 1992 p 205-207 (For primary document see N93-22606 08-18)
Avail: CASI HC A01/MF A04

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N93-22227*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEMONSTRATION OF AUTOMATED PROXIMITY AND DOCKING TECHNOLOGY Abstract Only
Robert L. Anderson (TRW, Inc., Redondo Beach, CA.), Roy K. Tsugawa (TRW, Inc., Redondo Beach, CA.), and Thomas C. Bryan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22234*# Sterling Software, Moffett Field, CA.
MANNED VERSUS UNMANNED RENDEZVOUS AND CAPTURE Abstract Only
Adam R. Brody *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22235*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTONOMOUS RENDEZVOUS AND CAPTURE DEVELOPMENT INFRASTRUCTURE Abstract Only
Thomas C. Bryan, Fred Roe, Cindy Coker, Pam Nelson, and B. Johnson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22239*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
US AUTOMATED RENDEZVOUS AND CAPTURE CAPABILITIES REVIEW. REMOTE UMBILICAL SYSTEM ABSTRACT Abstract Only
Eduardo Lopez delCastillo *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22242*# National Aeronautics and Space Administration, Washington, DC.
AUTONOMOUS RENDEZVOUS AND DOCKING: A COMMERCIAL APPROACH TO ON-ORBIT TECHNOLOGY VALIDATION Abstract Only
Peter Tchoryk, Jr. (Environmental Research Inst. of Michigan, Ann Arbor.), Michael E. Dobbs (Environmental Research Inst. of Michigan, Ann Arbor.), David J. Conrad (Environmental Research Inst. of Michigan, Ann Arbor.), Dale J. Apley (Environmental Research Inst. of Michigan, Ann Arbor.), and Raymond P. Whitten *In its* NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22243*# Martin Marietta Corp., Denver, CO. Space Operations Simulation Lab.
REAL-TIME SIMULATIONS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only
John A. Cuseo *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22245*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
IMP: A PERFORMANCE CODE Abstract Only
Vincent A. Dauro, Sr. *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22252*# General Dynamics Corp., San Diego, CA. Space Systems Div.
AUTONOMOUS RENDEZVOUS AND DOCKING OPERATIONS OF UNMANNED EXPENDABLE CARGO TRANSFER VEHICLES (E.G. CENTAUR) WITH SPACE STATION FREEDOM Abstract Only
Brian R. Emmet *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22253*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TRAC BASED SENSING FOR AUTONOMOUS RENDEZVOUS Abstract Only
Louis J. Everett (Texas A&M Univ., College Station.) and Leo Monford *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22261*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
VIRTUAL REALITY APPLICATIONS TO AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only
Joseph Hale and Daniel ONeil *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22266*# Fairchild Space Co., Germantown, MD.
ON-ORBIT DEMONSTRATION OF AUTOMATED CLOSURE AND CAPTURE USING ESA-DEVELOPED PROXIMITY OPERATIONS TECHNOLOGIES AND AN EXISTING, SERVICEABLE NASA EXPLORER PLATFORM SPACECRAFT Abstract Only
Bill Hohwiesner and Bernard Claudinon (MATRA Marconi Space, Toulouse, France.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22269*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE SHUTTLE PROGRAM: AUTOMATIC RENDEZVOUS, PROXIMITY OPERATIONS, AND CAPTURE (CATEGORY 3) Abstract Only
William L. Jackson, Roscoe Lee (TRW, Inc., Houston, TX.), Richard E. Eick (TRW, Inc., Houston, TX.), J. V. Hallstrom (Rockwell International Corp., Houston, TX.), Harry K. Hiers, John P. McManamen, Oscar W. Olszewski (Lockheed Engineering and Sciences Co., Houston, TX.), Joseph L. Prather, D. L. Rue (TRW, Inc., Houston, TX.), and Karl J. Zimmer *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22270*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.
CTV RENDEZVOUS TECHNIQUES Abstract Only
Jerry L. Jennings and Robert L. Anderson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22272*# General Dynamics Corp., San Diego, CA. Space Systems Div.
AN AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM USING CRUISE MISSILE TECHNOLOGIES Abstract Only
Ruel Edwin Jones *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22274*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AUTOMATIC RENDEZVOUS AND CAPTURE SYSTEM DEVELOPMENT IN A MANNED ENVIRONMENT Abstract Only
Peter M. Kachmar (Draper, Charles Stark Lab., Inc., Cambridge, MA.) and William L. Jackson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22280*# Rockwell International Corp., Houston, TX. Space Operations Div.
ONBOARD NAVIGATION RENDEZVOUS EXPERT SYSTEM Abstract Only
Michelle Kocen *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22281*# General Dynamics Corp., San Diego, CA. Space Systems Div.
AN OVERVIEW OF AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM TECHNOLOGY DEVELOPMENT AT GENERAL DYNAMICS Abstract Only
Fred Kuenzel *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22282*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AUTONOMOUS DOCKING GROUND DEMONSTRATION (CATEGORY 3) Abstract Only
Steve L. Lamkin, Richard E. Eick (TRW, Inc., Houston, TX.), James M. Baxter (TRW, Inc., Houston, TX.), M. G. Boyd (Lockheed Engineering and Sciences Co., Houston, TX.), Fred D. Clark (Lockheed Engineering and Sciences Co., Houston, TX.), Thomas Q. Lee, L. T. Othon, Joseph L. Prather, Peter T. Spehar (Lockheed Engineering and Sciences Co., Houston, TX.), and Rebecca J. Teders (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22284*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTONOMOUS RENDEZVOUS TARGETING TECHNIQUES FOR NATIONAL LAUNCH SYSTEM APPLICATION Abstract Only
James J. Lomas and A. Wayne Deaton *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22292*# McDonnell-Douglas Space Systems Co., Houston, TX.
USE OF AUTOMATED RENDEZVOUS TRAJECTORY PLANNING TO IMPROVE SPACECRAFT OPERATIONS EFFICIENCY Abstract Only
Tom A. Mulder *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22293*# General Dynamics Corp., San Diego, CA. Space Systems Div.
AN INTEGRATED AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM ARCHITECTURE USING CENTAUR MODERN AVIONICS Abstract Only
Kurt Nelson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22294*# TRW, Inc., Redondo Beach, CA. Engineering and Test Div.
COLLISION AVOIDANCE FOR CTV: REQUIREMENTS AND CAPABILITIES Abstract Only
Thomas P. Nosek *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22295*# McDonnell-Douglas Space Systems Co., Houston, TX.
PILOTING DECISION AID FOR SPACECRAFT PROXIMITY OPERATIONS Abstract Only
Cole J. Pierce *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22298*# Applied Research, Inc., Huntsville, AL.
AUTOMATED RENDEZVOUS AND DOCKING WITH VIDEO IMAGERY Abstract Only
Mike Rodgers and Larry Z. Kennedy *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22299*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.
SIX DEGREE OF FREEDOM SIMULATION SYSTEM FOR EVALUATING AUTOMATED RENDEZVOUS AND DOCKING SPACECRAFT Abstract Only
Kenneth H. Rourke and Roy K. Tsugawa *In* NASA, Washington, NASA

Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22302*# General Dynamics Corp., San Diego, CA. Space Systems Div.
THE DEVELOPMENT OF AN AUTONOMOUS RENDEZVOUS AND DOCKING SIMULATION USING RAPID INTEGRATION AND PROTOTYPING TECHNOLOGY Abstract Only
John H. Shackelford, John D. Saugen, Michael J. Wurst, and James Adler *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22304*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.
SIMULATION MODELS FOR AUTONOMOUS RENDEZVOUS AND CAPTURE Abstract Only
Nick G. Smith, Jim A. McKinnis, and Sid M. Early *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22305*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AUTOMATING AN ORBITER APPROACH TO SPACE STATION FREEDOM TO MINIMIZE PLUME IMPINGEMENT Abstract Only
Peter T. Spehar (Lockheed Engineering and Sciences Co., Houston, TX.) and Thomas Quan Le *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N93-22016*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
APPARATUS FOR SIMULATING AN EXOATMOSPHERIC STRUCTURE Patent Application
Robert Lynn Harvey, inventor (to NASA) 17 Feb. 1993 40 p
(NASA-Case-MSC-21975-1; NAS 1.71:MSC-21975-1;
US-Patent-Appl-SN-018844) Avail: CASI HC A03/MF A01

Apparatus for simulating an exoatmospheric structure, such as a spin stabilized satellite, in an environment subject to gravitational forces is presented. The apparatus includes a floating structure which is pivotally and rotationally supported upon a gimballed bearing structure positioned adjacent to the center of mass of the floating structure and suspended upon a support structure. The floating structure is translatable in either vertical direction relative to the supporting structure upon a vertically movable suspension system connected to the supporting structure. The supporting structure is provided with bearing assemblies which are adapted to engage a supporting surface for permitting freedom of movement of the supporting structure over the supporting structure in any direction. NASA

N93-22877*# Krug Life Sciences, Inc., Houston, TX.
ADVANCED UNDERWATER LIFT DEVICE
David T. Flanagan and Robert C. Hopkins (Houston Univ., Clear Lake, TX.) Mar. 1993 52 p Sponsored by NASA. Lyndon B. Johnson Space Center
(NASA-CR-185709; NAS 1.26:185709) Avail: CASI HC A04/MF A01

Flexible underwater lift devices ('lift bags') are used in underwater operations to provide buoyancy to submerged objects. Commercially available designs are heavy, bulky, and awkward to handle, and thus are limited in size and useful lifting capacity. An underwater lift device having less than 20 percent of the bulk and less than 10 percent of the weight of commercially available models was developed. The design features a dual membrane envelope, a nearly homogeneous envelope membrane stress distribution, and a minimum surface-to-volume ratio. A proof-of-concept model of 50 kg capacity was built and tested. Originally designed to provide buoyancy to mock-ups submerged in NASA's weightlessness simulators, the device may have application to water-landed spacecraft which must deploy flotation upon impact, and where launch weight and volume penalties are significant. The device may also be useful for the automated recovery of ocean floor probes or in marine salvage applications. Author (revised)

N93-24598* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SUSPENSION DEVICE FOR LOW-FREQUENCY STRUCTURES Patent
Meng-Sang Chew, inventor (to NASA), Jer-Nan Juang, inventor (to NASA), and Li-Farn Yang, inventor (to NASA) 4 May 1993 9 p Filed 28 Mar. 1991 supersedes N91-28184 (29 - 20, p 3289)
(NASA-Case-LAR-14272-1-CU; US-Patent-5,207,110;
US-Patent-Appl-SN-678553; US-Patent-Class-73-866.4;
US-Patent-Class-73-865.6; US-Patent-Class-248-328;
US-Patent-Class-434-34; Int-Patent-Class-B64G-7/00) Avail: US Patent and Trademark Office

A suspension device is provided for simulating the free-free boundary conditions of space for a low frequency structure. A support cable is connected at one end to the test structure and is vertically guided by a guiding ring. The other end of the cable is connected to a cam having an outer circumference which supports the cable. A drive axle passes through the cam center of rotation and is rotatably journalled in a suitable manner to a rigid structure. Two torsion springs are provided about the drive axle. One end of each spring is connected to a respective face of the cam and the other end is connected to the fixed support. The cam is shaped and the torsion springs selected such that Wr(sub (t)) = T(sub s(t)), wherein W is the weight of the test structure; r(sub (t)) is the instantaneous moment arm defined as the perpendicular distance from the rotational center of the cam to the cable at time t, and T(sub s(t)) is the total spring torque exerted by the two springs on the cam at time t. The test structure is accordingly vertically suspended by the cable and the instantaneous moment arm compensates for any increased spring torque arising from a vertical displacement of the test structure to simulate space conditions.
Official Gazette of the U.S. Patent and Trademark Office

N93-22231*# Lockheed Engineering and Sciences Co., Houston, TX.
SIX-DEGREE-OF-FREEDOM TEST FACILITY Abstract Only
Michelle A. Bittel *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22251*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A SYNTHETIC ENVIRONMENT FOR VISUALIZATION AND PLANNING OF ORBITAL MANEUVERS Abstract Only
Stephen R. Ellis (California Univ., Berkeley.) and Arthur J. Grunwald (Technion - Israel Inst. of Tech., Haifa.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22307*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.
EXPERIMENTAL VALIDATION OF DOCKING AND CAPTURE USING SPACE ROBOTICS TESTBEDS Abstract Only
John Spofford, Eric Schmitz, and William Hoff *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22309*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE MSFC SPACE STATION/SPACE OPERATIONS MECHANISM TEST BED Abstract Only
William G. Sutton and Patrick A. Tobbe (Logicon Control Dynamics Co., Huntsville, AL.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22310*# General Dynamics Corp., San Diego, CA. Space Systems Div.
THE ROLE OF SMART SYSTEMS IN RENDEZVOUS, CLOSE PROXIMITY OPERATIONS AND DOCKING MANEUVERS Abstract Only
Gerard P. Szatkowski *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22312*# Logicon Control Dynamics Co., Huntsville, AL.
AUTOMATIC RENDEZVOUS SYSTEM TESTING AT THE FLIGHT ROBOTICS LABORATORY Abstract Only
Patrick A. Tobbe and Charles B. Naumann *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12) (Contract NAS8-36570)
Avail: CASI HC A01/MF A03

N93-23827# Ruhr Univ., Bochum (Germany). Astronomical Inst.
THE ROLE OF PLANETARIUMS IN PROMOTING SPACE SCIENCES
Johannes Viktor Feitzinger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1343-1346 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23909# Ceskoslovenska Akademie Ved, Ondrejov. Astronomical Inst.
GROUND-BASED OPTICAL SUPPORT FOR GAMMA RAY SATELLITE ACTIVITIES
R. Hudec and P. Pravec *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 167-169 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23912# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
THE INFRARED SPACE OBSERVATORY (ISO)
A. Salama and M. F. Kessler *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 175-176 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23932# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.
INTEGRAL: INTERNATIONAL GAMMA RAY ASTROPHYSICS LABORATORY
Christoph Winkler *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 227 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24344# Italian Space Agency, Rome.
THE ROLE OF THE APM CENTRE TO SUPPORT COLUMBUS PRECURSOR FLIGHTS
Giovanni Rum, Claudio Canu, Luciano Battocchio (Alenia Spazio S.p.A., Turin, Italy.), and Mario Cardano (Alenia Spazio S.p.A., Turin, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 41-47 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24347# Dornier System G.m.b.H., Friedrichshafen (Germany).
TRAINING FACILITIES AT THE CREW TRAINING COMPLEX
C. Puetz, A. Torres (European Space Agency, Cologne, Germany.), and F. Demond (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 63-68 (For primary document see N93-24336 08-12)
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N93-24374# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Microgravity User Support Center.
THE MICROGRAVITY USER SUPPORT CENTER (MUSC)
K. Wittmann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 213-216 (For primary document see N93-24336 08-12)
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N93-24375# Microgravity Advanced Research and Support Center, Naples (Italy).
MICROGRAVITY ADVANCED RESEARCH AND SUPPORT (MARS) CENTER UPDATE
R. Monti and C. Mirra *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 217-220 (For primary document see N93-24336 08-12)
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N93-24378# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).
THE REFINED DECENTRALIZED CONCEPT AND DEVELOPMENT SUPPORT
H. T. Blume, T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), H. Duwe, N. Eilersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. Gaida, M. Herten, T.-H. Iversen (Trondheim Univ., Norway.), and C. Jungius et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 235-239 (For primary document see N93-24336 08-12)
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N93-24380# Microgravity Advanced Research and Support Center, Naples (Italy).
USER SUPPORT FOR THE COLUMBUS PRECURSOR MISSIONS
C. Mirra, T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), H. T. Blume (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo, H. Duwe (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), N. Eilersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. Gaida (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. Herten, and T.-H. Iversen (Trondheim Univ., Norway.) et al *In* ESA,

Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 245-249 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24390# Tecnospazio S.p.A., Milan (Italy).
COLUMBUS AUTOMATION TESTBED: A TOOL FOR USERS
G. Colombina, C. Jones (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), and W. dePeuter (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 295-299 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N93-22009*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
ROBUST NEIGHBORING OPTIMAL GUIDANCE FOR THE ADVANCED LAUNCH SYSTEM
David G. Hull Jan. 1993 34 p
(Grant NAG1-944)
(NASA-CR-192087; NAS 1.26:192087) Avail: CASI HC A03/MF A01

In recent years, optimization has become an engineering tool through the availability of numerous successful nonlinear programming codes. Optimal control problems are converted into parameter optimization (nonlinear programming) problems by assuming the control to be piecewise linear, making the unknowns the nodes or junction points of the linear control segments. Once the optimal piecewise linear control (suboptimal) control is known, a guidance law for operating near the suboptimal path is the neighboring optimal piecewise linear control (neighboring suboptimal control). Research conducted under this grant has been directed toward the investigation of neighboring suboptimal control as a guidance scheme for an advanced launch system. For individual titles, see N93-22010 through N93-22011.

N93-22010*# Texas Univ., Austin.
ADVANCED LAUNCH SYSTEM TRAJECTORY OPTIMIZATION USING SUBOPTIMAL CONTROL
Douglas A. Shaver and David G. Hull *In its* Robust Neighboring Optimal Guidance for the Advanced Launch System Jan. 1993 10 p (For primary document see N93-22009 08-15)
Avail: CASI HC A02/MF A01

The maximum-final mass trajectory of a proposed configuration of the Advanced Launch System is presented. A model for the two-stage rocket is given; the optimal control problem is formulated as a parameter optimization problem; and the optimal trajectory is computed using a nonlinear programming code called VF02AD. Numerical results are presented for the controls (angle of attack and velocity roll angle) and the states. After the initial rotation, the angle of attack goes to a positive value to keep the trajectory as high as possible, returns to near zero to pass through the transonic regime and satisfy the dynamic pressure constraint, returns to a positive value to keep the trajectory high and to take advantage of minimum drag at positive angle of attack due to aerodynamic shading of the booster, and then rolls off to negative values to satisfy the constraints. Because the engines cannot be throttled, the maximum dynamic pressure occurs at a single point; there is no maximum dynamic pressure subarc. To test approximations for obtaining analytical solutions for guidance, two additional optimal trajectories are computed: one using untrimmed aerodynamics and one using no atmospheric effects except for the dynamic pressure constraint. It is concluded that untrimmed aerodynamics has a negligible effect on the optimal trajectory and that approximate optimal controls should be able to be obtained by treating atmospheric effects as perturbations. Author

N93-22011*# Texas Univ., Austin.
NEIGHBORING SUBOPTIMAL CONTROL FOR VEHICLE GUIDANCE
David G. Hull and Michael J. Nowak *In its* Robust Neighboring Optimal Guidance for the Advanced Launch System Jan. 1993 11 p (For primary document see N93-22009 08-15)
Avail: CASI HC A03/MF A01

The neighboring optimal feedback control law is developed for systems with a piecewise linear control for the case where the optimal control is obtained by nonlinear programming techniques. To develop the control perturbation for a given deviation from the nominal path, the second variation is minimized subject to the constraint that the final conditions be satisfied (neighboring suboptimal control). This process leads to a feedback relationship between the control perturbation and the measured deviation from the nominal state. Neighboring suboptimal control is applied to the lunar launch problem. Two approaches, single optimization and multiple optimization for calculating the gains are used, and the gains are tested in a guidance simulation with a mismatch in the acceleration of gravity. Both approaches give acceptable results, but multiple optimization keeps the perturbed path closer to the nominal path. Author

N93-22899# Space Policy Advisory Board, Washington, DC. Office of the Vice President.
FUTURE OF THE US SPACE LAUNCH CAPABILITY: A TASK GROUP REPORT
Nov. 1992 50 p
(PB93-139947) Avail: CASI HC A03/MF A01

In July 1992, a special task group of the Space Policy Advisory Board reviewed the nation's Space Launch Strategy approved by the President in July 1991. The report contains the findings and recommendations of the Task Group. The Task Group has provided a set of recommendations from a 'national' perspective that will improve our nation's space launch capability, make us more competitive in the international marketplace, and reduce the cost of government space launch operations. The U.S. should start a single, completely new, 'Spacelifter' space launch vehicle program. The Spacelifter program would focus on the medium performance range, but be 'modular' in its performance capability. The task group also recommends a transition plan to phase out the older and expensive space launch vehicles, including the Space Shuttle. The task group further recommends that a centralized management structure be established to oversee Spacelifter and other space launch activities. Derived from text

N93-23486# IAP Research, Inc., Dayton, OH.
A MULTIPLE ARMATURE RAILGUN LAUNCHER Final Report, Aug. 1989 - Apr. 1992
Mark W. Heyse, Antonios Challita, Brian L. Maas, and David P. Bauer Jan. 1993 12 p
(Contract F08635-89-C-0285)
(AD-A259768; WL-TR-92-013) Avail: CASI HC A03/MF A01

As longer projectiles are accelerated, the efficiency (projectile mass/launch mass) of the launch package decreases. The reduction in efficiency makes launching projectiles with a L/D (length-to-diameter ratio) greater than 20 undesirable. EM guns have several launch characteristics that differ from conventional guns. Higher launch velocities are achievable in EM guns because sonic gas velocities do not limit the projectile velocity. Acceleration profiles for EM guns are more constant. The acceleration forces can be distributed on the projectile easily because the accelerating force can be distributed with multiple armatures. These characteristics combine to make EN guns a very attractive approach for launching very long (i.e.. high L/D ratio) projectiles. Railgun launchers with multiple armatures can distribute the accelerating force. Each armature is supplied gun current for acceleration through its own set of rails. This multi-rail, multi-armature concept was tested at the railgun test facility. The results demonstrated feasibility. We were able to control current distribution to multiple armatures. This paper describes the theory and test results for multi-armature launch of high L/D projectiles. GRA

N93-23685# Oak Ridge National Lab., TN.
ELECTRON-BEAM ROCKET ACCELERATION OF HYDROGEN PELLETS

C. C. Tsai, C. A. Foster, S. L. Milora, D. E. Schechter, and J. H. Whealton 1992 20 p Presented at the 39th National Symposium of the American Vacuum Society, Chicago, IL, 9-13 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-002822; CONF-921129-2) Avail: CASI HC A03/MF A01

A proof-of-principle device for characterizing electron-beam rocket pellet acceleration has been developed and operated during the last few years. Experimental data have been collected for thousands of accelerated hydrogen pellets under a variety of beam conditions. One intact hydrogen pellet was accelerated to a speed of 578 m/s by an electron beam of 10 kV, 0.8 A, and 1 ms. The collected data reveal the significant finding that the measured burn velocity of bare hydrogen pellets increases with the square of the beam voltage in a way that is qualitatively consistent with the theoretical prediction based on the neutral gas shielding (NGS) model. The measured burn velocity increases with the beam current or power and then saturates at values two to three times greater than that predicted by the NGS model. The discrepancy may result from low pellet strength and large beam-pellet interaction areas. Moreover, this feature may be the cause of the low measured exhaust velocity, which often exceeds the sonic velocity of the ablated gas. Consistent with the NGS model, the measured exhaust velocity increases in direct proportion to the beam current and in inverse proportion to the beam voltage. To alleviate the pellet strength problem, experiments have been performed with the hydrogen ice contained in a lightweight rocket casing or shell. Pellets in such sabots have the potential to withstand higher beam powers and achieve higher thrust-coupling efficiency. Some experimental results are reported and ways of accelerating pellets to higher velocity are discussed. DOE

N93-24250# Orbital Sciences Corp., Chandler, AZ. Space Data Div.
SPIRIT 2 VEHICLE: (A26.780). POST FLIGHT REPORT Final Report, 21 Dec. 1988 - 28 Mar. 1992
C. P. Chalfant 26 May 1992 28 p
(Contract F19628-89-C-0028)
(AD-A259991; PL-TR-92-2175; AD-E201341) Avail: CASI HC A03/MF A01

The Spirit 2 Launch Vehicle System was launched successfully from Poker Flat Research Range on 28 Mar. 1992. All flight objectives were achieved, and a peak altitude of 326 km was achieved. The vehicle liftoff weight was 20,092 pounds. The first stage, powered by the Talos motor, boosted the vehicle to an altitude of 6000 feet. The first stage experienced minor wind disturbances. The second stage, an Aries motor (a surplus solid propellant motor from the Minuteman 1 missile), performed as predicted. The inertial guidance system achieved the pre-programmed burnout conditions. The spent second stage impacted 157 km uprange. GRA

N93-22083*# Martin Marietta Corp., Denver, CO. Astronautics Group.
NATIONAL LAUNCH SYSTEM: STRUCTURES AND MATERIALS
Jack O. Bunting *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 20-2 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

N93-22236*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
NATIONAL LAUNCH SYSTEM OVERVIEW WITH FOCUS ON CARGO TRANSFER VEHICLE Abstract Only
Harry Buchanan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N93-22081*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SPACE TRANSPORTATION MATERIALS AND STRUCTURES TECHNOLOGY WORKSHOP. VOLUME 2: PROCEEDINGS
Frank W. Cazier, Jr., comp. and James E. Gardner, comp. Washington Feb. 1993 442 p Workshop held in Newport News, VA, 23-26 Sep. 1991
(RTOP 506-43-31-07)
(NASA-CP-3148-Vol-2; L-17181-Vol-2; NAS 1.55:3148-Vol-2) Avail: CASI HC A19/MF A04

The Space Transportation Materials and Structures Technology Workshop was held on September 23-26, 1991, in Newport News, Virginia. The workshop, sponsored by the NASA Office of Space Flight and the NASA Office of Aeronautics and Space Technology, was held to provide a forum for communication within the space materials and structures technology developer and user communities. Workshop participants were organized into a Vehicle Technology Requirements session and three working panels: Materials and Structures Technologies for Vehicle Systems, Propulsion Systems, and Entry Systems. For individual titles, see N93-22082 through N93-22118.

N93-22082*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CARGO VEHICLE ARCHITECTURE OPTIONS
R. Eugene Austin *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 13-1 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The sessions featured are: (1) the earth-to-orbit cargo; (2) the manned earth-to-orbit cargo systems; (3) the manned transfer vehicles; and (4) the advanced propulsion. CASI

N93-22083*# Martin Marietta Corp., Denver, CO. Astronautics Group.
NATIONAL LAUNCH SYSTEM: STRUCTURES AND MATERIALS c15
Jack O. Bunting *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 20-2 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The National Launch System provides an opportunity to realize the potential of Al-Li. Advanced structures can reduce weights by 5-40 percent as well as relax propulsion system performance specifications and reduce requirements for labor and materials. The effect on costs will be substantial. Advanced assembly and process control technologies also offer the potential for greatly reduced labor during the manufacturing and inspection processes. Current practices are very labor-intensive and, as a result, labor costs far outweigh material costs for operational space transportation systems. The technological readiness of new structural materials depends on their commercial availability, producibility and materials properties. Martin Marietta is vigorously pursuing the development of its Weldalite 049 Al-Li alloys in each of these areas. Martin Marietta is also preparing to test an automated work cell concept that it has developed using discrete event simulation. CASI

N93-22084*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ADVANCED MANNED LAUNCH SYSTEM
Theodore A. Talay *In its* Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 27-38 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

Several alternatives exist for the development of the next manned launch system. The Advanced Manned Launch System (AMLS), which represents a clean-sheet replacement for the Space Shuttle, faces

competition from concepts such as (1) the Personnel Launch System, which would serve as a personnel transport to complement the Space Shuttle, and (2) an advanced version of the existing Space Shuttle. An AMLS system could begin operations sometime between 2005 and 2020, depending upon the level of national interest and support. It would probably demonstrate a payload capacity less than that of the Space Shuttle, although performance specifications are far from certain. Even the form of the AMLS is still under discussion. Design studies have considered a wide variety of options including all levels of hardware reusability; single-, dual- and multiple-staging; and airbreathing vs. rocket propulsion. An evaluation of the relative cost-effectiveness of these options is impossible without guidance regarding basic mission requirements such as total number of launches over the system's life cycle and the date required. The availability of more advanced technologies will enable single-stage-to-orbit (SSTO) designs that are in general not feasible using current technology. Author

N93-22085*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ADVANCED CREW RESCUE VEHICLE/PERSONNEL LAUNCH SYSTEM

Jerry W. Craig *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 39-6 (For primary document see N93-22081 08-16)

Avail: CASI HC A03/MF A04

The Advanced Crew Rescue Vehicle (ACRV) will be an essential element of the Space Station to respond to three specific missions, all of which have occurred during the history space exploration by the U.S. and the Soviets: (1) Mission DRM-1: Return of disabled crew members during medical emergencies; (2) Mission DRM-2: Return of crew members from accidents or as a result of failures of Space Station systems; and (3) Mission DRM-3: Return of crew members during interruption of Space Shuttle launches. The ACRV will have the ability to transport up to eight astronauts during a 24-hour mission. Not only would the ACRV serve as a lifeboat to provide transportation back to Earth, but it would also be available as a immediately available safe refuge in case the Space Station were severely damaged by space debris or other catastrophe. Upon return to Earth, existing world-wide search and rescue assets operated by the Coast Guard and Department of Defense would be able to retrieve personnel returned to Earth via the ACRV. The operational approach proposed for the ACRV is tailored to satisfying mission requirements for simplicity of operation (no piloting skills or specially trained personnel are required), continuous availability, high reliability and affordability. By using proven systems as the basis for many critical ACRV systems, the ACRV program is more likely to achieve each of these mission requirements. Nonetheless, the need for the ACRV to operate reliably with little preflight preparation after, perhaps, 5 to 10 years in orbit imposes challenges not faced by any previous space system of this complexity. Specific concerns exist regarding micrometeoroid impacts, battery life, and degradation of recovery parachutes while in storage. Author

N93-22086*# Strategic Defense Initiative Organization, Washington, DC.

SINGLE STAGE TO ORBIT/SDIO

James R. French (JRF Engineering Services, La Canada, CA.) *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 66-7 (For primary document see N93-22081 08-16)

Avail: CASI HC A02/MF A04

This paper included a discussion of the United States' need for a launch system that demonstrates both high capacity and low cost. Current systems, which typically require two years' lead time to provide on-orbit service to space platforms, are too inflexible for many missions. A system is needed that is able to operate in much the same way as existing commercial aircraft. The SSTO program is focused on satisfying aircraft-like operations and logistics support requirements such as engine-out intact abort capability and seven-day, 350-man-day vehicle turnaround times. Author

N93-22087*# Martin Marietta Corp., Denver, CO.

LUNAR TRANSFER VEHICLE STUDIES

Joseph T. Keeley *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 77-9 (For primary document see N93-22081 08-16)

Avail: CASI HC A03/MF A04

Lunar transportation architectures exist for several different mission scenarios. Direct flights from Earth are possible, as the Apollo program clearly demonstrated. Alternatively, a space transfer vehicle could be constructed in space by using the Space Station as a base of operations, or multiple vehicles could be launched from Earth and dock in LEO without using a space station for support. Similarly, returning personnel could proceed directly to Earth or rendezvous at the Space Station for a ride back home on the Space Shuttle. Multiple design concepts exist which are compatible with these scenarios and which can support requirements of cargo, personnel, and mission objectives. Regardless of the ultimate mission selected, some technologies will certainly play a key role in the design and operation of advanced lunar transfer vehicles. Current technologies are capable of delivering astronauts to the lunar surface, but improvements are needed to affordably transfer the material and equipment that will be needed for establishing a lunar base. Materials and structures advances, in particular, will enable the development of more capable cryogenic fluid management and propulsion systems, improved structures, and more efficient vehicle assembly, servicing and processing. Author

N93-22088*# Boeing Co., Huntsville, AL.

MARS TRANSFER VEHICLE STUDIES

Gordon Woodcock *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 93-104 (For primary document see N93-22081 08-16)

Avail: CASI HC A03/MF A04

Earth-to-Mars distances vary from 60 to 400 million kilometers over a 14-year cycle. This complicates Mars mission design as a function of calendar time. Stay times at Mars are also strongly driven by opportunities for a return flight path which are within the limits of delta-V associated with practical space vehicles. The biggest difference between Mars and lunar transfer missions is mission time, which grows from a few days for the moon, to as much as a few hundred days for Mars missions. As a result, modules for similarly sized crews must be much larger for Mars missions that for transfer to lunar orbit. Technology challenges for one Mars mission scenario analyzed by Boeing include aerobrakes, propulsion, and life support systems. Mission performance is very sensitive to aerobrake weight fraction and, as a result, there is an incentive to use high performance materials such as advanced composites and thermal protection systems. Lander aerobrake would be used twice (for both planetary capture and descent to the Mars surface), and it would need to survive temperatures up to 3500 degrees. Author

N93-22089*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

AEROBRAKING TECHNOLOGY STUDIES

Charles H. Eldred *In its* Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 105-117 (For primary document see N93-22081 08-16)

Avail: CASI HC A03/MF A04

For a Mars Expedition, aerobrakes can play a vital role in several major mission events, including aerocapture to achieve orbit and descent to the planetary surface both at Mars and upon return to Earth. The feasibility of aerobrake designs will depend upon material and structures technologies because they will serve as a key factor in determining: (1) aerobrake mass and mass fraction; (2) the extent to which aerobrakes can survive the thermal environment. This is especially important for reusable aerobrakes. With the cancellation of the Aeroassist Flight Experiment, the effort to validate aerobrake designs has focused on laboratory test and analysis; (3) the feasibility of assembling and/or deploying large aerobrakes. On-orbit assembly is a critical issue for all spacecraft intended for Mars exploration missions. Current studies are addressing options related to inspace assembly and construction; and (4) configuration lift-to-drag (L/D) ratio. High L/D increases convective heating, whereas low L/D emphasizes radiative heating. In general, the lowest L/D design that can satisfy mission requirements is preferred. Author

N93-22090*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CSTI EARTH-TO-ORBIT PROPULSION RESEARCH AND TECHNOLOGY PROGRAM OVERVIEW **c20**
Steven J. Gentz *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 119-130 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

NASA supports a vigorous Earth-to-orbit (ETO) research and technology program as part of its Civil Space Technology Initiative. The purpose of this program is to provide an up-to-date technology base to support future space transportation needs for a new generation of lower cost, operationally efficient, long-lived and highly reliable ETO propulsion systems by enhancing the knowledge, understanding and design methodology applicable to advanced oxygen/hydrogen and oxygen/hydrocarbon ETO propulsion systems. Program areas of interest include analytical models, advanced component technology, instrumentation, and validation/verification testing. Organizationally, the program is divided between technology acquisition and technology verification as follows: (1) technology acquisition; and (2) technology verification. Author

N93-22091*# Aerojet-General Corp., Sacramento, CA. Propulsion Div.
ADVANCED ROCKET PROPULSION **c20**
Charles J. OBrien *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 131-137 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

Existing NASA research contracts are supporting development of advanced reinforced polymer and metal matrix composites for use in liquid rocket engines of the future. Advanced rocket propulsion concepts, such as modular platelet engines, dual-fuel dual-expander engines, and variable mixture ratio engines, require advanced materials and structures to reduce overall vehicle weight as well as address specific propulsion system problems related to elevated operating temperatures, new engine components, and unique operating processes. High performance propulsion systems with improved manufacturability and maintainability are needed for single stage to orbit vehicles and other high performance mission applications. One way to satisfy these needs is to develop a small engine which can be clustered in modules to provide required levels of total thrust. This approach should reduce development schedule and cost requirements by lowering hardware lead times and permitting the use of existing test facilities. Modular engines should also reduce operational costs associated with maintenance and parts inventories. Author

N93-22092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE PROPULSION **c20**
John M. Kazaroff *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 138-142 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

Lewis Research Center is developing broad-based new technologies for space chemical engines to satisfy long-term needs of ETO launch vehicles and other vehicles operating in and beyond Earth orbit. Specific objectives are focused on high performance LO2/LH2 engines providing moderate thrusts of 7,5-200 klb. This effort encompasses research related to design analysis and manufacturing processes needed to apply advanced materials to subcomponents, components, and subsystems of space-based systems and related ground-support equipment. High-performance space-based chemical engines face a number of technical challenges. Liquid hydrogen turbopump impellers are often so large that they cannot be machined from a single piece, yet high stress at the vane/shroud interface makes bonding extremely difficult. Tolerances on fillets are critical on large impellers. Advanced materials and fabricating techniques are needed to address these and other issues of interest. Turbopump bearings are needed which can provide reliable, long life operation at high speed and high load with low friction losses. Hydrostatic bearings provide good performance, but transients during pump starts and stops may be an issue because no pressurized fluid is available unless a separate bearing pressurization system is included. Durable materials and/or coatings are needed that can demonstrate low wear in the harsh LO2/LH2 environment. Advanced materials are also needed to improve the lifetime, reliability and performance of other propulsion system elements such as seals and chambers. Author

N93-22093*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUCLEAR CONCEPTS/PROPULSION **c20**
Thomas J. Miller *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 143-147 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

Nuclear thermal and nuclear electric propulsion systems will enable and/or enhance important space exploration missions to the moon and Mars. Current efforts are addressing certain research areas, although NASA and DOE still have much work yet to do. Relative to chemical systems, nuclear thermal propulsion offers the potential of reduced vehicle weight, wider launch windows. and shorter transit times, even without aerobrakes. This would improve crew safety by reducing their exposure to cosmic radiation. Advanced materials and structures will be an important resource in responding to the challenges posed by safety and test facility requirements, environmental concerns, high temperature fuels and the high radiation, hot hydrogen environment within nuclear thermal propulsion systems. Nuclear electric propulsion (NEP) has its own distinct set of advantages relative to chemical systems. These include low resupply mass, the availability of large amounts of onboard electric power for other uses besides propulsion, improved launch windows, and the ability to share technology with surface power systems. Development efforts for NEP reactors will emphasize long life operation of compact designs. This will require designs that provide high fuel burnup and high temperature operation along with personnel and environmental safety. Author

N93-22094*# Thiokol Corp., Huntsville, AL. Space Operations.
SOLID ROCKET MOTORS **c20**
Ronn L. Carpenter *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 148-164 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

Structural requirements, materials and, especially, processing are critical issues that will pace the introduction of new types of solid rocket motors. Designers must recognize and understand the drivers associated with each of the following considerations: (1) cost; (2) energy density; (3) long term storage with use on demand; (4) reliability; (5) safety of processing and handling; (6) operability; and (7) environmental acceptance.
Derived from text

N93-22095*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
VEHICLE SYSTEMS
Tom Bales, Tom Modlin (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.), Jack Suddreth (Spectra Research Systems, Inc., Arlington, VA.), Tom Wheeler (Schafer, W. J. Associates, Inc., Arlington, VA.), Darrel R. Tenney, Ernest O. Bayless (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.), W. Barry Lisagor, Donald A. Bolstad (Martin Marietta Corp., New Orleans, LA.), Harold Croop (Wright Lab., Wright-Patterson AFB, OH.), and J. Dyer (General Dynamics Corp., Saint Louis, MO.) et al *In its* Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 187-207 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

Perspectives of the subpanel on expendable launch vehicle structures and cryotanks are: (1) new materials which provide the primary weight savings effect on vehicle mass/size; (2) today's investment; (3) typically 10-20 years to mature and fully characterize new materials. CASI

N93-22096*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PROPULSION SYSTEMS PANEL **c20**
Carmelo J. Bianca, Robert Miner (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), Lawrence M. Johnston, R. Bruce (National Aeronautics and Space Administration. John

C. Stennis Space Center, Bay Saint Louis, MS.), Daniel P. Dennies (Aerojet-General Corp., Sacramento, CA.), W. Dickenson (National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.), Robert Dreshfield (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), Walt Karakulko (Lockheed Engineering and Sciences Co., Houston, TX.), Mike McGaw (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), and Paul M. Munafo et al *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 210-256 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

Topics addressed are: (1) cryogenic tankage; (2) launch vehicle TPS/insulation; (3) durable passive thermal control devices and/or coatings; (4) development and characterization of processing methods to reduce anisotropy of material properties in Al-Li; (5) durable thermal protection system (TPS); (6) unpressurized Al-Li structures (interstages, thrust structures); (7) near net shape sections; (8) pressurized structures; (9) welding and joining; (10) micrometeoroid and debris hypervelocity shields; (11) state-of-the-art shell buckling structure optimizer program to serve as a rapid design tool; (12) test philosophy; (13) reduced load cycle time; (14) structural analysis methods; (15) optimization of structural criteria; and (16) develop an engineering approach to properly trade material and structural concepts selection, fabrication, facilities, and cost. CASI

N93-22097*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ENTRY SYSTEMS PANEL **c18**
Daniel J. Rasky, Donald R. Rummler (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.), Charlie Bersch (Institute for Defense Analyses, Alexandria, VA.), and Sidney C. Dixon (Schafer, W. J. Associates, Inc., Arlington, VA.) *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 259-270 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

As general findings, lessons learned from shuttle are: (1) bridge established between development center (JSC) Research Centers (ARC, LARC), and industry (RI, LMSC, Corning, Mansville, 3M LTV, Union Carbide, Hexcel) for shuttle TPS; (2) not all test results adequately analyzed or in hindsight, completely encompassing all failure modes; (3) gap heating effects from ground facilities not totally indicative of flight experience; (4) need to design with operations in mind (not just to cost) example: moisture intrusion of GR/EP, many other examples; (5) RSI- developed as point design for maneuvering entry vehicle of high L/D; and (6) RSI - 15 years from invention to use on flight hardware. CASI

N93-22098*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
VEHICLE SYSTEMS PANEL DELIBERATIONS
Tom Bales, Tom Modlin (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.), Jack Suddreth (Spectra Research Systems, Inc., Arlington, VA.), Tom Wheeler (Schafer, W. J. Associates, Inc., Arlington, VA.), Darrel R. Tenney, Ernest O. Bayless (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.), W. Barry Lisagor, Donald A. Bolstad (Martin Marietta Corp., New Orleans, LA.), Harold Croop (Wright Lab., Wright-Patterson AFB, OH.), and J. Dyer (General Dynamics Corp., Saint Louis, MO.) et al *In its* Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 271-276 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The Vehicle Systems Panel addressed materials and structures technology issues related to launch and space vehicle systems not directly associated with the propulsion or entry systems. The Vehicle Systems Panel was comprised of two subpanels - Expendable Launch Vehicles & Cryotanks (ELVC) and Reusable Vehicles (RV). Tom Bales, LaRC, and Tom Modlin, JSC, chaired the expendable and reusable vehicles subpanels, respectively, and co-chaired the Vehicle Systems Panel. The following four papers are discussed in this section: (1) Net Section components for Weldalite Cryogenic Tanks, by Don Bolstad; (2) Build-up Structures for Cryogenic Tanks and Dry Bay Structural Applications, by Barry Lisagor; (3) Composite Materials Program, by Robert Van Siclen; (4) Shuttle Technology (and M&S Lessons Learned), by Stan Greenberg. Author

N93-22099*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
BUILT-UP Al-Li STRUCTURES FOR CRYOGENIC TANK AND DRY BAY APPLICATIONS **c18**
W. Barry Lisagor *In its* Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 279-287 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The objectives are: (1) to demonstrate the cost benefits of built-up cryotank and dry bay structures; (2) to study of benefits of using Al alloys; (3) to study of benefit of using Al-Li alloys; (4) to evaluate alternative low-cost stiffener and joining concepts. CASI

N93-22100*# Rockwell International Corp., Downey, CA. Space Div.
ORBITER LESSONS LEARNED: A GUIDE TO FUTURE VEHICLE DEVELOPMENT
Harry Stan Greenberg *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 289-294 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

Topics addressed are: (1) wind persistence loads methodology; (2) emphasize supportability in design of reusable vehicles; (3) design for robustness; (4) improved aerodynamic environment prediction methods for complex vehicles; (5) automated integration of aerothermal, manufacturing, and structures analysis; (6) continued electronic documentation of structural design and analysis; and (7) landing gear rollout load simulations. CASI

N93-22101*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PROPULSION SYSTEMS PANEL DELIBERATIONS **c20**
Carmelo J. Bianca, Robert Miner (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), Lawrence M. Johnston, R. Bruce (National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.), Daniel P. Dennies (Aerojet-General Corp., Sacramento, CA.), W. Dickenson (National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.), Robert Dreshfield (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), Walt Karakulko (Lockheed Engineering and Sciences Co., Houston, TX.), Mike McGaw (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), and Paul M. Munafo et al *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 295-300 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The Propulsion Systems Panel was established because of the specialized nature of many of the materials and structures technology issues related to propulsion systems. This panel was co-chaired by Carmelo Bianca, MSFC, and Bob Miner, LeRC. Because of the diverse range of missions anticipated for the Space Transportation program, three distinct propulsion system types were identified in the workshop planning process: liquid propulsion systems, solid propulsion systems and nuclear electric/nuclear thermal propulsion systems. Author

N93-22102*# United Technologies Corp., San Jose, CA. Chemical Systems Div.
HYBRID ROCKET PROPULSION **c20**
Allen L. Holzman *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 303-319 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

Topics addressed are: (1) comparison of the theoretical impulses; (2) comparison of the density-specific impulses; (3) general propulsion system features comparison; (4) hybrid systems, booster applications; and (5) hybrid systems, upper stage propulsion applications. CASI

N93-22103*# PDA Engineering, Costa Mesa, CA.
RELIABILITY OF SOLID ROCKET MOTOR CASES AND NOZZLES
James G. Crose *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 321-325 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

A recent article in Aerospace America claims that 'the average success ratio of the current U.S. stable of launch vehicles, including upper stages, is about 92 percent (without upper stages it is close to 95 percent). The 8 percent failure probability implies an expected loss of $12M per flight, not including the lost opportunity costs'. Since payload costs are likely to be much greater than launch costs and even more so for the new launch vehicles for the Advanced Launch Development Program (ALDP), the cost of rocket motor unreliability at the current 8 percent rate can run into billions of dollars if expected increases in demand are realized. At an 8 percent failure rate, it is extremely unlikely that failure will occur during the first few ground tests of a new system. At that time, most of the design, analysis and tooling costs of the program have not expended. Since most systems are expected to be used ten to a hundred or more times, the likelihood of one or more failures is very large, and it can be expected that the above losses will be realized in the future. This will occur unless the problems are addressed and remedied. Recent trends suggest the problem is not being addressed adequately. Author

N93-22104*# Science Applications International Corp., San Diego, CA.
SOLID PROPULSION INTEGRITY PROGRAM (SPIP) FOR VERIFIABLE ENHANCED SOLID ROCKET MOTOR RELIABILITY
Barry L. Butler *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 327-328 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

To increase the success rate of U.S. built Rocket Motors (SRM), the approach taken is: (1) set common reliability goals for nozzles, cases, bondline, propellant, and insulation; (2) build a common engineering data base to support standard industry-wide reliability assessment models; (3) structure or enhance existing industry/government/user term to develop the tools, methods needed, and the data to support them; and (4) areas where unreliabilities are found must be improved. CASI

N93-22105*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ENTRY SYSTEMS PANEL DELIBERATIONS **c18**
Daniel J. Rasky, Donald R. Rummler (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.), Charlie Bersch (Institute for Defense Analyses, Alexandria, VA.), and Sidney C. Dixon (Schafer, W. J. Associates, Inc., Arlington, VA.) *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 329-333 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The Entry Systems Panel was chaired by Don Rummler, LaRC and Dan Rasky, ARC. As requested, each panel participant prior to the workshop prepared and delivered presentations to: (1) identify technology needs; (2) assess current programs; (3) identify technology gaps; and (4) identify highest payoff areas R&D. Participants presented background on the entry systems R&D efforts and operations experiences for the Space Shuttle Orbiter. These participants represented NASA Centers involved in research (Ames Research Center), development (Johnson Space Center) and operations (Kennedy Space Center) and the Shuttle Orbiter prime contractor. The presentations lead to the discovery of several lessons learned. Author

N93-22106*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE ASSEMBLED ENTRY SYSTEMS CERTIFICATION
Donald M. Curry *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 337-344 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The approach taken to the issue, that 'How do you say you're 'good for go' if you space assemble an entry vehicle?', are: (1) shuttle orbiter thermal protection certification; (2) shuttle thermal protection system flight experience; and (3) space assembled entry system certification. CASI

N93-22107*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
THERMAL PROTECTION SYSTEM OF THE SPACE SHUTTLE'S ORBITER
Frank E. Jones *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 347-357 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

It is the teams view that there is a general lack of awareness of orbiter tile susceptibility to damage by debris - the same applies to the care and critical nature of the shuttle elements and operations process so necessary to minimizing damaging debris - it is essential that all involved employees, both government and contractor, understand that minuscule loose objects or materials coming off the elements will most likely cause some tile damage at the speed encountered during ascent. It is recommended that descriptive material, photos, video tape, debris samples and other appropriate matter be assembled and provided to the proper organizations for dissemination to their employees - it should emphasize that the tiles perform outstanding in their debris-free design environment; but, are extremely sensitive to small particle damage. Author

N93-22108*# Rockwell International Corp., Downey, CA. Space Systems Div.
REENTRY SYSTEMS: MATERIAL TECHNOLOGY NEEDS **c18**
Richard Michael Ehret *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 359-362 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

The material technology needs are: (1) lightweight and durable rigid insulating and higher temperature flexible materials; and (2) inspection, repair, producibility, and maintainability of refractory composites. The direction of efforts are: (1) funding base is relatively small for future years; (2) to minimize returns, collaborative programs appear to be practical; and (3) SSD's approach is to implement NASA developed technology. CASI

N93-22109*# McDonnell-Douglas Space Systems Co., Huntington Beach, CA.
THERMAL PROTECTION SYSTEMS FOR ALL-WEATHER REUSABLE LAUNCH VEHICLES **c18**
Marc J. Giegerich *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 363-367 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

The topics addressed are: (1) thermal protection system technology needs; and (2) long-term, reusable thermal protection materials, such as recently developed materials (CMC's, metallics, ceramics, etc.), which require ground and flight testing, basic materials whose properties are properties verified/quantified, and load-carrying hot structured and controlled surfaced materials. CASI

N93-22110*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THERMAL PROTECTION SYSTEMS FOR AEROBRAKES
Stephen S. Tompkins *In its* Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 369-373 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

In summary, advantages of the ablative thermal protection system (TPS) for aerobrakes are: (1) proven reliable TPS systems; (2) well characterized (thermally) with good, existing thermal analysis capability; (3) good candidate materials are available; (4) not sensitive to defects and more difficult to damage then RSI or C-C; (5) design program which demonstrated simple (direct bond) application of large panels; (6) thermal excursions not catastrophic; and (7) no SIP required. CASI

N93-22111*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
FLEXIBLE THERMAL PROTECTION MATERIALS FOR ENTRY SYSTEMS
Demetrius A. Kourtides *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 375-380 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

Current programs addressed in aeroassist flight experiment are: (1) evaluation of thermal performance of advanced rigid and flexible insulations and reflective coating; (2) investigation of lighter than baseline materials; (3) investigation of rigid insulations which perform well; (4) study of flexible insulations which require ceramic coating; and (5) study of reflective coating effective at greater than 15 percent. In National Aerospace Plane (NASP), the programs addressed are: (1) high and low temperature insulations; and (2) attachment/standoff methodology critical which affects thermal performance. CASI

N93-22112*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CERAMIC MATRIX COMPOSITES (CONTINUOUS FIBER REINFORCED) THERMAL PROTECTION SYSTEMS **c24**
Salvatore R. Riccitiello *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 385-389 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

Concluded remarks are: (1) advanced carbon-carbon (ACC) substrate fabrication technology in good shape; (2) ACC coating improvements satisfactory but additional work needed; (3) non-destructive test techniques to monitor hardware during operational life needed; and (4) cost reduction approaches a high priority. CASI

N93-22113*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THERMAL PROTECTION SYSTEMS FOR SPACE TRANSPORTATION VEHICLES
Howard E. Goldstein *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 391-402 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

The topics addressed are history of reusable external insulation (RSI), and examples of shuttle RSI development challenges, which includes: (1) manufacturing of raw materials, such as fibers, coating components; (2) design of tile planform size, strain isolation, and gap heating; (3) insulation, such as bonding, bond verification, tolerances, and quality control; and (4) operation, such as durability, and water proofing. CASI

N93-22114*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THERMAL PROTECTION MATERIALS AT NASA AMES RESEARCH CENTER
Daniel J. Rasky *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 405-410 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The topics addressed are: (1) Space Exploration Initiative (SEI); (2) Aeroassist Flight Experiment (AFE); (3) Mars Environmental Survey (MESUR); (4) National Aero-space Plan (NASP); (5) Pegasus and Pegasus/SWERVE Hypersonic Testing; and (6) Personnel Launch System TPS evaluation. CASI

N93-22115*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SOME MATERIALS PERSPECTIVES FOR SPACE TRANSPORTATION SYSTEMS
Howard G. Maahs *In its* Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 413-421 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The topics addressed are: personal background in entry systems; and common needs for space transportation vehicles - passive thermal protection systems; and an aerobrake concept. CASI

N93-22116*# Sandia National Labs., Albuquerque, NM.
MATERIALS AND STRUCTURES TECHNOLOGIES FOR HYPERSONICS
George F. Wright, Jr. *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 423-428 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The topics of current programs of material and structures for hypersonics are: (1) National Aero-Space Plane (NASP) supports most programs (100M + for materials); and (2) NASA generic hypersonics. CASI

N93-22117*# Lockheed Missiles and Space Co., Sunnyvale, CA.
RIGID FIBROUS CERAMICS FOR ENTRY SYSTEMS **c27**
Ronald P. Banas *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 431-436 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

The topics addressed are: (1) high payoff areas with reusable surface insulation; (2) technology opportunities/gap; (3) coatings for rigid fibrous ceramics; (4) challenges for reusable rigid fibrous ceramics - Lunar/Mars aerobraking heatshield; (5) comparison of LI-900 and HTP properties; and (6) comparison of microstructures. CASI

N93-22118*# General Dynamics Corp., San Diego, CA. Space Systems Div.
ENTRY SYSTEMS TECHNOLOGY ASSESSMENT
Archie Gay *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 439-442 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

The objectives are: (1) to establish aerothermal environments for hypersonic aerospace vehicles; (2) to develop thermostructural design concepts; (3) to obtain optimum thermostructural designs by performing trade studies; and (4) to identify areas for further development. CASI

N93-22348*# Boeing Aerospace and Electronics Co., Huntsville, AL. Advanced Civil Space Systems.
SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS. IMPLEMENTATION PLAN AND ELEMENT DESCRIPTION DOCUMENT. VOLUME 1: MAJOR TRADES. BOOK 1: DRAFT FINAL
15 Feb. 1991 369 p
(Contract NAS8-37857)
(NASA-CR-192488; NAS 1.26:192488; D615-10026-1-Vol-1) Avail: CASI HC A16/MF A03

This document presents trade studies and reference concept designs accomplished during a study of Space Transfer Concepts and Analyses for Exploration Missions (STCAEM). This volume contains the major top level trades, level 2 trades conducted in support of NASA's Lunar/Mars Exploration Program Office, and a synopsis of the vehicles for different propulsion systems under trade consideration. The vehicles are presented in more detail in other volumes of this report. Book 1 of Volume 1 covers the following analyses: lunar/Mars commonality trades, lunar/Mars mission operations, and Mars transfer systems. Author

N93-22386*# General Dynamics Corp., Groton, CT. Space Systems Div.
TRANSPORTATION SYSTEMS ANALYSES, VOLUME 2 Semiannual Report, 10 May - 30 Oct. 1992
6 Nov. 1992 90 p
(Contract NAS8-39209)
(NASA-CR-192486; NAS 1.26:192486) Avail: CASI HC A05/MF A01

The principal objective is to accomplish a systems engineering assessment of the nation's space transportation infrastructure. This analysis addresses the necessary elements to perform man delivery and return, cargo transfer, cargo delivery, payload servicing, and the exploration of the Moon and Mars. Specific elements analyzed, but not limited to, include the Space Exploration Initiative (SEI), the National Launch System (NLS), the current expendable launch vehicle (ELV) fleet, ground facilities, the Space

Station Freedom (SSF), and other civil, military, and commercial payloads. The performance entails maintaining a broad perspective on the large number of transportation elements that could potentially comprise the U.S. space infrastructure over the next several decades. To perform this systems evaluation, top-level trade studies are conducted to enhance our understanding of the relationships between elements of the infrastructure. This broad 'infrastructure-level perspective' permits the identification of preferred infrastructures. Sensitivity analyses are performed to assure the credibility and usefulness of study results. Conceptual studies of transportation elements contribute to the systems approach by identifying elements (such as ETO node and transfer/excursion vehicles) needed in current and planned transportation systems. These studies are also a mechanism to integrate the results of relevant parallel studies.

Author (revised)

N93-22669*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

DEBRIS/ICE/TPS ASSESSMENT AND INTEGRATED PHOTOGRAPHIC ANALYSIS FOR SHUTTLE MISSION STS-54 Final Report, 12-21 Jan. 1993

Gregory N. Katnik, Scott A. Higginbotham, and J. Bradley Davis Mar. 1993 146 p Original contains color illustrations

(NASA-TM-107558; NAS 1.15:107558) Avail: CASI HC A07/MF A02; 63 functional color pages

A Debris/Ice/TPS assessment and integrated photographic analysis was conducted for Shuttle Mission STS-54. Debris inspections of the flight elements and launch pad were performed before and after launch. Ice/frost conditions on the External Tank were assessed by the use of computer programs, nomographs, and infrared scanner data during cryogenic loading of the vehicle followed by on-pad visual inspection. High speed photography was analyzed after launch to identify ice/debris sources and evaluate potential vehicle damage and/or in-flight anomalies. This report documents the debris/ice/TPS conditions and integrated photographic analysis of Shuttle Mission STS-54, and the resulting effect on the Space Shuttle Program.

Author

N93-22702*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

TASK ANALYSIS OF SHUTTLE ENTRY AND LANDING ACTIVITIES

Albert W. Holland and Stephen T. VanderArk (Krug Life Sciences, Inc., Houston, TX.) Mar. 1993 50 p

(NASA-TM-104761; S-710; NAS 1.15:104761) Avail: CASI HC A03/MF A01

The Task Analysis of Shuttle Entry and Landing (E/L) Activities documents all tasks required to land the Orbiter following an STS mission. In addition to analysis of tasks performed, task conditions are described, including estimated time for completion, altitude, relative velocity, normal and lateral acceleration, location of controls operated or monitored, and level of g's experienced. This analysis precedes further investigations into potential effects of zero g on piloting capabilities for landing the Orbiter following long-duration missions. This includes, but is not limited to, researching the effects of extended duration missions on piloting capabilities. Four primary constraints of the analysis must be clarified: (1) the analysis depicts E/L in a static manner--the actual process is dynamic; (2) the task analysis was limited to a paper analysis, since it was not feasible to conduct research in the actual setting (i.e., observing or filming duration an actual E/L); (3) the tasks included are those required for E/L during nominal, daylight conditions; and (4) certain E/L tasks will vary according to the flying style of each commander.

Author (revised)

N93-22705*# Boeing Co., Huntsville, AL. Defense and Space Group.

SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS Final Report, May - Sep. 1992

Gordon R. Woodcock Nov. 1992 179 p

(Contract NAS8-37857)

(NASA-CR-192482; NAS 1.26:192482; D615-10060) Avail: CASI HC A09/MF A02

The current technical effort is part of the third phase of a broad-scoped and systematic study of space transfer concepts for human lunar and Mars missions. The study addressed the technical issues relating to the First Lunar Outpost (FLO) habitation vehicle with emphasis on the structure, power, life support system, and radiation environment for a baseline habitat with specific alternatives for the baseline.

Author (revised)

N93-22959*# Boeing Aerospace and Electronics Co., Huntsville, AL. Advanced Civil Space Systems.

SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS. IMPLEMENTATION PLAN AND ELEMENT DESCRIPTION DOCUMENT. VOLUME 1: MAJOR TRADES. BOOK 2: DRAFT FINAL

15 Feb. 1991 681 p

(Contract NAS8-37857)

(NASA-CR-192489; NAS 1.26:192489; D615-10026-1-Vol-1) Avail: CASI HC A99/MF A06

Topics addressed are: (1) an artificial gravity assessment study; (2) Mars mission transport vehicle (MTV)/Mars excursion vehicle (MEV) mission scenarios; (3) aerobrake issues; (4) equipment life and self-check; (5) earth-to-orbit (ETO) heavy lift launch vehicle (HLLV) definition trades; and (6) risk analysis.

Author

N93-22960*# Boeing Aerospace and Electronics Co., Huntsville, AL. Advanced Civil Space Systems.

SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS. IMPLEMENTATION PLAN AND ELEMENT DESCRIPTION DOCUMENT (DRAFT FINAL). VOLUME 3: NUCLEAR THERMAL ROCKET VEHICLE

8 Mar. 1991 450 p

(Contract NAS8-37857)

(NASA-CR-192491; NAS 1.26:192491; D615-10026-3-Vol-3) Avail: CASI HC A19/MF A04

This document presents the nuclear thermal rocket (NTR) concept design developed in support of the Space Transfer Concepts and Analysis for Exploration Missions (STCAEM) study. The evolution of the NTR concept is described along with the requirements, guidelines and assumptions for the design. Operating modes and options are defined and a systems description of the vehicle is presented. Artificial gravity configuration options and space and ground support systems are discussed. Finally, an implementation plan is presented which addresses technology needs, schedules, facilities and costs.

Author

N93-22990*# Boeing Aerospace and Electronics Co., Huntsville, AL. Advanced Civil Space Systems.

SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS. IMPLEMENTATION PLAN AND ELEMENT DESCRIPTION DOCUMENT (DRAFT FINAL). VOLUME 5: NUCLEAR ELECTRIC PROPULSION VEHICLE

8 Mar. 1991 460 p

(Contract NAS8-37857)

(NASA-CR-192493; NAS 1.26:192493; D615-10026-5-Vol-5) Avail: CASI HC A20/MF A04

The nuclear electric propulsion (NEP) concept design developed in support of the Space Transfer Concepts and Analysis for Exploration Missions (STCAEM) study is presented. The evolution of the NEP concept is described along with the requirements, guidelines, and assumptions for the design. Operating modes and options are defined and a systems description of the vehicle is presented. Artificial gravity configuration options and space and ground support systems are discussed. Finally, an implementation plan is presented which addresses technology needs, schedules, facilities and costs.

Author

N93-22993*# Boeing Aerospace and Electronics Co., Huntsville, AL.

SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS. IMPLEMENTATION PLAN AND ELEMENT DESCRIPTION DOCUMENT (DRAFT FINAL). VOLUME 4: SOLAR ELECTRIC PROPULSION VEHICLE

8 Mar. 1991 487 p

(Contract NAS8-37857)

(NASA-CR-192492; NAS 1.26:192492; D615-10026-4-Vol-4) Avail: CASI HC A21/MF A04

This document presents the solar electric propulsion (SEP) concept design developed as part of the Space Transfer Concepts and Analysis for Exploration Missions (STCAEM) study. The evolution of the SEP concept is described along with the requirements, guidelines and assumptions for the design. Operating modes and options are defined and a systems

description of the vehicle is presented. Artificial gravity configuration options and space and ground support systems are discussed. Finally, an implementation plan is presented which addresses technology needs, schedules, facilities, and costs. Author

N93-22995*# United Technologies Corp., Huntsville, AL.
SUMMARY DOCUMENT OF TASKS PERFORMED ON THE SHUTTLE-C/NLS CONTRACT
10 Jan. 1993 429 p Original contains color illustrations
(Contract NAS8-37145)
(NASA-CR-192483; NAS 1.26:192483) Avail: CASI HC A19/MF A04; 10 functional color pages

During FY92, USBI performed many programmatic related tasks. These programmatic tasks have been categorized as follows: (1) acquisition; (2) project engineering/program planning; and (3) cost. The reports associated with these tasks follow in paragraphs 1.1.1 through 1.3.3. Proceeding each task report is a brief description of the contents contained within. Author

N93-23007*# Boeing Aerospace and Electronics Co., Huntsville, AL. Advanced Civil Space Systems.
SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS. IMPLEMENTATION PLAN AND ELEMENT DESCRIPTION DOCUMENT (DRAFT FINAL). VOLUME 6: LUNAR SYSTEMS
8 Mar. 1991 296 p
(Contract NAS8-37857)
(NASA-CR-192494; NAS 1.26:192494; D615-10026-6-Vol-6) Avail: CASI HC A13/MF A03

NASA's two Office of Space Flight (Code M) Space Transfer Vehicle (STV) contractors supported development of Space Exploration Initiative (SEI) lunar transportation concepts. This work treated lunar SEI missions as the far end of a more near-term STV program, most of whose missions were satellite delivery and servicing requirements derived from Civil Needs Data Base (CNDB) projections. Space Transfer Concepts and Analysis for Exploration Missions (STCAEM) began to address the complete design of a lunar transportation system. The following challenges were addressed: (1) the geometry of aerobraking; (2) accommodation of mixed payloads; (3) cryogenic propellant transfer in Low Lunar Orbit (LLO); (4) fully re-usable design; and (5) growth capability. The leveled requirements, derived requirements, and assumptions applied to the lunar transportation system design are discussed. The mission operations section includes data on mission analysis studies and performance parametrics as well as the operating modes and performance evaluations which include the STCAEM recommendations. Element descriptions for the lunar transportation family included are a listing of the lunar transfer vehicle/lunar excursion vehicle (LTV/LEV) components; trade studies and mass analyses of the transfer and excursion modules; advanced crew recovery vehicle (ACRV) (modified crew recovery vehicle (MCRV)) modifications required to fulfill lunar operations; the aerobrake shape and L/D to be used; and some costing methods and results. Commonality and evolution issues are also discussed. CASI

N93-23008*# General Dynamics Corp., San Diego, CA. Space Systems Div.
TRANSPORTATION SYSTEMS ANALYSES. VOLUME 1: EXECUTIVE SUMMARY Semiannual Report, 10 May - 30 Oct. 1992
6 Nov. 1992 27 p
(Contract NAS8-39209)
(NASA-CR-192485; NAS 1.26:192485) Avail: CASI HC A03/MF A01

The principal objective is to accomplish a systems engineering assessment of the nation's space transportation infrastructure. This analysis addresses the necessary elements to perform crew delivery and return, cargo transfer, cargo delivery and return, payload servicing, and the exploration of the Moon and Mars. Specific elements analyzed, but not limited to, include: the Space Exploration Initiative (SEI), the National Launch System (NLS), the current expendable launch vehicle (ELV) fleet, ground facilities, the Space Station Freedom (SSF), and other civil, military and commercial payloads. The performance of this study entails maintaining a broad perspective on the large number of transportation elements that could potentially comprise the U.S. space infrastructure over the next several decades. To perform this systems evaluation, top-level trade studies are conducted to enhance our understanding of the relationship between elements of the infrastructure. This broad 'infrastructure-level perspective' permits the identification of preferred infrastructures. Sensitivity analyses are performed to assure the credibility and usefulness of study results. Conceptual studies of transportation elements contribute to the systems approach by identifying elements (such as ETO node and transfer/excursion vehicles) needed in current and planned transportation systems. These studies are also a mechanism to integrate the results of relevant parallel studies. Author

N93-23085*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
DEBRIS/ICE/TPS ASSESSMENT AND INTEGRATED PHOTOGRAPHIC ANALYSIS OF SHUTTLE MISSION STS-53
Gregory N. Katnik, Scott A. Higginbotham, and J. Bradley Davis Jan. 1993 141 p Original contains color illustrations
(NASA-TM-107556; NAS 1.15:107556) Avail: CASI HC A07/MF A02; 64 functional color pages

A Debris/Ice/TPS assessment and integrated photographic analysis was conducted for Shuttle Mission STS-53. Debris inspections of the flight elements and launch pad were performed before and after launch. Ice/Frost conditions on the External Tank were assessed by the use of computer programs, nomographs, and infrared scanner data during cryogenic loading of the vehicle followed by on-pad visual inspection. High speed photography was analyzed after launch to identify ice/debris sources and evaluate potential vehicle damage and/or in-flight anomalies. This report documents the debris/ice/TPS conditions and integrated photographic analysis of Shuttle Mission STS-53, and the resulting effect on the Space Shuttle Program. Author

N93-23251*# Boeing Aerospace and Electronics Co., Huntsville, AL. Advanced Civil Space Systems.
SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS. IMPLEMENTATION PLAN AND ELEMENT DESCRIPTION DOCUMENT (DRAFT FINAL). VOLUME 2: CRYO/AEROBRAKE VEHICLE Final Report
8 Mar. 1991 597 p
(Contract NAS8-37857)
(NASA-CR-192490; NAS 1.26:192490; D615-10026-2-Vol-2) Avail: CASI HC A25/MF A06

The cryogenic/aerobrake (CAB) and the cryogenic all-propulsive (CAP) concept designs developed in support of the Space Transfer Concepts and Analysis for Exploration Missions (STCAEM) study are presented. The evolution of the CAB and CAP concepts is described along with the requirements, guidelines and assumptions for the designs. Operating modes and options are defined and systems descriptions of the vehicles are presented. Artificial gravity configuration options and space and ground support systems are discussed. Finally, an implementation plan is presented which addresses technology needs, schedules, facilities, and costs. Author (revised)

N93-23732*# National Aeronautics and Space Administration, Washington, DC.
FROM SHIP TO SHUTTLE: NASA ORBITER NAMING PROGRAM, SEPTEMBER 1988 - MAY 1989
Oct. 1991 205 p Original contains color illustrations
(NASA-EP-276; NAS 1.19:276) Avail: CASI HC A10/MF A03; 67 functional color pages

By congressional action in 1987, the National Aeronautics and Space Administration (NASA) was authorized to provide an opportunity for American school students to name the new Space Shuttle orbiter being built to replace the Challenger. The Council of Chief State School Officers (CCSSO), an education organization representing the chief education officials of the nation, was asked by NASA to assist in the development and administration of this exciting and important educational activity. A selection of interdisciplinary activities related to the Space Shuttle that were designed by students for the NASA Orbiter-Naming Program are presented. The national winner's project is first followed by other projects listed in alphabetical order by state, and a bibliography compiled from suggestions by the state-level winning teams. Author

N93-24522*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AERODYNAMIC CHARACTERISTICS OF A PROPOSED PERSONNEL LAUNCH SYSTEM (PLS) LIFTING-BODY CONFIGURATION AT MACH NUMBERS FROM 0.05 TO 20.3 (Diskette Supplement)
Christopher I. Cruz, George M. Ware, Sue B. Grafton, William C. Woods, and James C. Young Nov. 1989 161 p Diskette supplement: IBM compatible 5.25-inch DSDD
(RTOP 506-49-11-01)
(NASA-TM-101641; NAS 1.15:101641; NONP-Suppl-DK-93-159782) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A13

A wind-tunnel investigation was performed to determine the aerodynamic characteristics of a proposed lifting-body personnel launch system (PLS) configuration over a Mach range of 0.05 to 20.3. The test configuration had a low-aspect-ratio body with a flat undersurface and three fins on the upper aft body. Data are presented with a minimum of analysis. All of the experimental data were placed in a structured data base using the R:BASE system and are included on two floppy disks enclosed in the back of this report. Author (revised)

N93-22249*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE REAL-TIME OPERATIONS OF THE SPACE SHUTTLE ORBITER DURING RENDEZVOUS AND PROXIMITY OPERATIONS Abstract Only
Andrew Dougherty and Chris Meyer (Rockwell Space Operations Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N93-22589*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ANALYSIS OF MMIC ARRAYS FOR USE IN THE ACTS AERO EXPERIMENT
M. Zimmerman (Analex Corp., Brook Park, OH.), R. Lee, E. Rho, and Z. Zaman Mar. 1993 29 p
(RTOP 506-72-1C)
(NASA-TM-106073; E-7682; NAS 1.15:106073) Avail: CASI HC A03/MF A01

The Aero Experiment is designed to demonstrate communication from an aircraft to an Earth terminal via the ACTS. This paper describes the link budget and antenna requirements for a 4.8 kbps full-duplex voice link at Ka-Band frequencies. Three arrays, one transmit array developed by TI and two receive arrays developed by GE and Boeing, were analyzed. The predicted performance characteristics of these arrays are presented and discussed in the paper. Author

N93-22683*# Research Inst. for Computing and Information Systems, Houston, TX.
APPLICATION OF FUZZY LOGIC-NEURAL NETWORK BASED REINFORCEMENT LEARNING TO PROXIMITY AND DOCKING OPERATIONS: SPECIAL APPROACH/DOCKING TESTCASE RESULTS
Yashvant Jani (Togai InfraLogic, Inc., Houston, TX.) 30 Jan. 1993 44 p (Contract NCC9-16; RICIS Proj. AR-06)
(NASA-CR-192294; NAS 1.26:192294) Avail: CASI HC A03/MF A01

As part of the RICIS project, the reinforcement learning techniques developed at Ames Research Center are being applied to proximity and docking operations using the Shuttle and Solar Maximum Mission (SMM) satellite simulation. In utilizing these fuzzy learning techniques, we use the Approximate Reasoning based Intelligent Control (ARIC) architecture, and so we use these two terms interchangeably to imply the same. This activity is carried out in the Software Technology Laboratory utilizing the Orbital Operations Simulator (OOS) and programming/testing support from other contractor personnel. This report is the final deliverable D4 in our milestones and project activity. It provides the test results for the special testcase of approach/docking scenario for the shuttle and SMM satellite. Based on our experience and analysis with the attitude and translational controllers, we have modified the basic configuration of the reinforcement learning algorithm in ARIC. The shuttle translational controller and its implementation in ARIC is described in our deliverable D3. In order to simulate the final approach and docking operations, we have set-up this special testcase as described in section 2. The ARIC performance results for these operations are discussed in section 3 and conclusions are provided in section 4 along with the summary for the project. Author

N93-22703*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RISK MANAGEMENT IN FLY-BY-WIRE SYSTEMS
Karyn T. Knoll Mar. 1993 23 p
(NASA-TM-104757; S-700; NAS 1.15:104757) Avail: CASI HC A03/MF A01

A general description of various types of fly-by-wire systems is provided. The risks inherent in digital flight control systems, like those used in the Space Shuttle, are identified. The results of a literature survey examining risk management methods in use throughout the aerospace industry are presented. The applicability of these methods to the Space Shuttle program is discussed. Author

N93-23111# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
ON THE NAVIGATION OF POLAR ORBITING METEOROLOGICAL SATELLITES
Jaroslav Klokocnik (Ondrejov Observatory, Czechoslovakia.), Peter Schluessel (Hamburg Univ., Germany.), Jan Kostelecky (Research Inst. of Geodesy, Prague, Czechoslovakia.), and Hartmut Grassl (Hamburg Univ., Germany.) Oct. 1991 88 p
(MPIM-75; ETN-93-93446) Avail: CASI HC A05/MF A01

Satellite navigation, a process of identifying the space and time coordinates of the satellite data products (for example image), is introduced. An explanation of why satellite navigation without ground control points is tied to satellite orbit determination and prediction (ephemerides) is given. Software for the direct and inverse referencing (ORBITS, PIXPO) was studied and improved, or replaced by another software (ORBITEST, PIXPO 3 and 4). The validation tests performed showed that the accuracy achieved in determination of the time of culmination (or pixel line) and in the off nadir angle (or pixel number) is comparable to the present pixel size for the NOAA-N satellites, that is 1 to 5 km, provided that the orbital elements (NASA two line elements) are not older than about two weeks. The main obstacle for a further significant improvement is the low quality of the orbital elements. ESA

N93-22162*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
A THREE CHANNEL TELEMETRY SYSTEM
Jeffery C. Lesho and Harry A. C. Eaton *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 129-136 (For primary document see N93-22149 08-99)
(NASA Order S-92635)
Avail: CASI HC A02/MF A04

N93-22241*# Lockheed Engineering and Sciences Co., Houston, TX.
APPLICABILITY OF RELATIVE GPS TO AUTOMATED RENDEZVOUS BETWEEN THE SPACE SHUTTLE AND SPACE STATION Abstract Only
Fred D. Clark and Ann Christofferson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22276*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RELATIVE NAVIGATION REQUIREMENTS FOR AUTOMATIC RENDEZVOUS AND CAPTURE SYSTEMS Abstract Only
Peter M. Kachmar (Draper, Charles Stark Lab., Inc., Cambridge, MA.), Robert J. Polutchko (Draper, Charles Stark Lab., Inc., Cambridge, MA.), William Chu (Draper, Charles Stark Lab., Inc., Cambridge, MA.), and Moises

Montez *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22289*# Lockheed Engineering and Sciences Co., Houston, TX. Intelligent Systems Dept.
A NAVIGATION AND CONTROL SYSTEM FOR AN AUTONOMOUS RESCUE VEHICLE IN THE SPACE STATION ENVIRONMENT Abstract Only
Lawrence Merkel *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
(Contracts NAS9-15800; NAS9-17900)
Avail: CASI HC A01/MF A03

N93-22301*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OFFICE OF SPACE FLIGHT STANDARD SPACEBORNE GLOBAL POSITIONING SYSTEM USER EQUIPMENT PROJECT Abstract Only
Penny E. Saunders *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22316*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTONOMOUS RECONFIGURABLE GPS/INS NAVIGATION AND POINTING SYSTEM FOR RENDEZVOUS AND DOCKING Abstract Only
Triveni N. Upadhyay (Mayflower Communications Co., Inc., Reading, MA.), Stephen Cotterill (Mayflower Communications Co., Inc., Reading, MA.), and A. Wayne Deaton *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22318*# Microcosm, Inc., Torrance, CA.
FULLY AUTONOMOUS NAVIGATION FOR THE NASA CARGO TRANSFER VEHICLE Abstract Only
James R. Wertz and E. David Skulsky *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-24376# Microgravity Advanced Research and Support Center, Naples (Italy).
TELESCIENCE OPPORTUNITIES IN THE PRECURSOR FLIGHTS
R. Fortezza and K. Wittmann (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 221-226 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N93-22013*# Grumman Aerospace Corp., Bethpage, NY.
MSFC THREE POINT DOCKING MECHANISM DESIGN REVIEW
Otto Schaefer and Anthony Ambrosio Dec. 1992 73 p
(Contract NAS8-36641)
(NASA-CR-192462; NAS 1.26:192462; ATS-92-1) Avail: CASI HC A04/MF A01

In the next few decades, we will be launching expensive satellites and space platforms that will require recovery for economic reasons, because of initial malfunction, servicing, repairs, or out of a concern for post lifetime debris removal. The planned availability of a Three Point Docking Mechanism (TPDM) is a positive step towards an operational satellite retrieval infrastructure. This study effort supports NASA/MSFC engineering work in developing an automated docking capability. The work was performed by the Grumman Space & Electronics Group as a concept evaluation/test for the Tumbling Satellite Retrieval Kit. Simulation of a TPDM capture was performed in Grumman's Large Amplitude Space Simulator (LASS) using mockups of both parts (the mechanism and payload). Similar TPDM simulation activities and more extensive hardware testing was performed at NASA/MSFC in the Flight Robotics Laboratory and Space Station/Space Operations Mechanism Test Bed (6-DOF Facility). Derived from text

N93-22458*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ROBUSTNESS
R. Ryan Mar. 1993 60 p
(NASA-TP-3336; M-716; NAS 1.60:3336) Avail: CASI HC A04/MF A01

Robustness is a buzz word common to all newly proposed space systems design as well as many new commercial products. The image that one conjures up when the word appears is a 'Paul Bunyon' (lumberjack design), strong and hearty; healthy with margins in all aspects of the design. In actuality, robustness is much broader in scope than margins, including such factors as simplicity, redundancy, desensitization to parameter variations, control of parameter variations (environments flucation), and operational approaches. These must be traded with concepts, materials, and fabrication approaches against the criteria of performance, cost, and reliability. This includes manufacturing, assembly, processing, checkout, and operations. The design engineer or project chief is faced with finding ways and means to inculcate robustness into an operational design. First, however, be sure he understands the definition and goals of robustness. This paper will deal with these issues as well as the need for the requirement for robustness. Author

N93-22459*# Analytical Mechanics Associates, Inc., Hampton, VA.
TRAJECTORY OPTIMIZATION BASED ON DIFFERENTIAL INCLUSION Final Report
Hans Seywald Washington Feb. 1993 26 p
(Contract NAS1-18935; RTOP 506-59-61-02)
(NASA-CR-4501; NAS 1.26:4501) Avail: CASI HC A03/MF A01

A method for generating finite-dimensional approximations to the solutions of optimal control problems is introduced. By employing a description of the dynamical system in terms of its attainable sets in favor of using differential equations, the controls are completely eliminated from the system model. Besides reducing the dimensionality of the discretized problem compared to state-of-the-art collocation methods, this approach also alleviates the search for initial guesses from where standard gradient search methods are able to converge. The mechanics of the new method are illustrated on a simple double integrator problem. The performance of the new algorithm is demonstrated on a 1-D rocket ascent problem ('Goddard Problem') in presence of a dynamic pressure constraint. Author

N93-22489# Defence Research Agency, Farnborough (England).
ELECTROSTATIC CHARGING OF SPACECRAFT IN GEOSYNCHRONOUS ORBIT Ph.D. Thesis - London Univ., 1991
Andrew J. Sims 17 Dec. 1992 170 p Original contains color illustrations
(DRA-TM-Space-389; BR316597) Copyright Avail: CASI HC A08/MF A02

This Memorandum is a study of the spacecraft charging phenomenon applicable to satellites in geosynchronous orbit. Differential charging of spacecraft surfaces can induce electrostatic discharges which may manifest themselves as 'operational anomalies' or permanent damage to surface features such as solar cells and thermal control surfaces. Understanding of the problem is achieved via laboratory experiments, analysis of data from spacecraft instrumentation, and by numerical simulation. Long-term statistical studies are presented for the location of plasma boundaries at geostationary altitude and for the occurrence frequency and intensity of

geomagnetic substorms which permit the probability of severe charging conditions to be predicted for future missions. Laboratory experiments are used to demonstrate the importance of bulk and surface conductivity of dielectric materials to the charging process and a sensitivity analysis is employed to investigate the detailed interaction between the plasma environment and spacecraft surface materials. Finally, a study and simulation of charging events observed in geosynchronous orbit is presented.

Author (revised)

N93-22551*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SPACE STATION FREEDOM BETA GIMBAL CONTROL VIA SENSITIVITY MODELS

David A. Schoenwald (Martin Marietta Energy Systems, Inc., Oak Ridge, TN.), Umit Ozguner (Ohio State Univ., Columbus.), and Ronald E. Graham Jan. 1993 10 p

(NASA-TM-106000; E-7543; NAS 1.15:106000) Avail: CASI HC A02/MF A01

Tracking control of the Space Station Freedom solar array beta gimbals is investigated. Of particular interest is the issue of control in the presence of uncertainty in gimbal friction parameters. Sensitivity functions are incorporated into the feedback loop to desensitize the gimbal control law to parameter variations. Simulation results indicated that one such sensitivity function improves the closed-loop performance of the gimbals in the presence of unexpected friction parameter dispersions. Author

N93-22554*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.

AN ANALYSIS OF POWER BEAMING FOR THE MOON AND MARS

Mark W. Stavnes Aug. 1992 8 p Presented at the 27th Intersociety Energy Conversion Engineering Conference, San Diego, CA, 3-7 Aug. 1992

(Contract NAS3-25266; RTOP 506-41-41)

(NASA-CR-191072; E-7581; NAS 1.26:191072) Avail: CASI HC A02/MF A01

Operations on the surface of the Moon and Mars will depend on a reliable source of electrical power. At NASA Lewis Research Center, the feasibility of powering lunar and Martian surface sites by power beaming was studied. Constellations of nuclear or solar powered satellites using microwave or laser transmitters were designed to power an equatorial surface base. Additional surface assets, such as rovers, can also be powered from the same orbiting satellites, requiring only the additional mass of a receiver. However, the actual mass and power capabilities of the system are dependent on the location of the surface receiver. The masses of the beam power systems can be reduced by up to 50 percent, by using the power source of an electric propulsion vehicle to power the beam system. The important analyses results and any additional issues that remain unresolved are discussed. Author

N93-22583# Sandia National Labs., Albuquerque, NM.

WHIPPLE BUMPER SHIELD RESULTS AND CTH SIMULATIONS AT VELOCITIES IN EXCESS OF 10 km/s

L. C. Chhabildas, E. S. Hertel, Jr., W. D. Reinhart, and J. M. Miller Sep. 1992 61 p

(Contract DE-AC04-76DP-00789)

(DE93-006932; SAND-91-2683) Avail: CASI HC A04/MF A01

A series of experiments has been performed on the Sandia HyperVelocity Launcher (HVL) to evaluate the effectiveness of a Whipple bumper shield to orbital space debris at impact velocities in excess of 10 km/s. Upon impact by a 0.67 g (0.87 mm thick) flier plate, the thin aluminum bumper shield disintegrates into a debris cloud. The debris cloud front propagates axially at velocities' of approximately 14 km/s and expands radially at a velocity of approximately 7 km/s. Subsequent loading on a 3.2 mm thick aluminum substructure by the debris penetrates the substructure completely. However, when the mass of the flier plate is reduced to 0.33 g, the substructure, although damaged, is not perforated over the duration of the experiment. Numerical simulations performed using the multi-dimensional hydrodynamics code CTH also predict complete penetration of the substructure by the subsequent debris cloud for a 0.87 g flier plate. The numerical simulations for a 0.33 g flier plate show a strong dependence on assumed impact geometry. For the assumption of a spherical projectile impact geometry, perforation of the substructure by the subsequent debris cloud is not predicted by CTH. DOE

N93-22587*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PRELIMINARY OARE ABSOLUTE ACCELERATION MEASUREMENTS ON STS-50

Robert C. Blanchard, John Y. Nicholson (Vigyan Research Associates, Inc., Hampton, VA.), and James Ritter (Lockheed Engineering and Sciences Co., Hampton, VA.) Feb. 1993 30 p

(RTOP 506-48-11-05)

(NASA-TM-107724; NAS 1.15:107724) Avail: CASI HC A03/MF A01

On-orbit Orbital Acceleration Research Experiment (OARE) data on STS-50 was examined in detail during a 2-day time period. Absolute acceleration levels were derived at the OARE location, the orbiter center-of-gravity, and at the STS-50 spacelab Crystal Growth Facility. The tri-axial OARE raw acceleration measurements (i.e., telemetered data) during the interval were filtered using a sliding trimmed mean filter in order to remove large acceleration spikes (e.g., thrusters) and reduce the noise. Twelve OARE measured biases in each acceleration channel during the 2-day interval were analyzed and applied to the filtered data. Similarly, the in situ measured x-axis scale factors in the sensor's most sensitive range were also analyzed and applied to the data. Due to equipment problem(s) on this flight, both y- and z- axis sensitive range scale factors were determined in a separate process (using the OARE maneuver data) and subsequently applied to the data. All known significant low-frequency corrections at the OARE location (i.e., both vertical and horizontal gravity-gradient, and rotational effects) were removed from the filtered data in order to produce the acceleration components at the orbiter's center-of-gravity, which are the aerodynamic signals along each body axes. Results indicate that there is a force of unknown origin being applied to the Orbiter in addition to the aerodynamic forces. The OARE instrument and all known gravitational and electromagnetic forces were reexamined, but none produce the observed effect. Thus, it is tentatively concluded that the Orbiter is creating the environment observed. Author

N93-22606*# National Aeronautics and Space Administration, Washington, DC.

SPACE STATION FREEDOM UTILIZATION CONFERENCE

1992 553 p Conference held in Huntsville, AL, 3-6 Aug. 1992

(NASA-TM-108742; NAS 1.15:108742) Avail: CASI HC A24/MF A04

The topics addressed in Space Station Freedom Utilization Conference are: (1) space station freedom overview and research capabilities; (2) space station freedom research plans and opportunities; (3) life sciences research on space station freedom; (4) technology research on space station freedom; (5) microgravity research and biotechnology on space station freedom; and (6) closing plenary. For individual titles, see N93-22607 through N93-22652.

N93-22607*# National Aeronautics and Space Administration, Washington, DC.

SPACE STATION FREEDOM UTILIZATION CONFERENCE: EXECUTIVE SUMMARY

In its Space Station Freedom Utilization Conference 1992 p 3-31 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

From August 3-6, 1992, Space Station Freedom Program (SSFP) representatives and prospective Space Station Freedom researchers gathered at the Von Braun Civic Center in Huntsville, Alabama, for NASA's first annual Space Station Freedom (SSF) Utilization Conference. The sessions presented are: (1) overview and research capabilities; (2) research plans and opportunities; (3) life sciences research; (4) technology research; (4) microgravity research and biotechnology; and (5) closing plenary.

CASI

N93-22608*# National Aeronautics and Space Administration, Washington, DC.

INTRODUCTION TO SPACE STATION FREEDOM

Richard Kohrs *In its* Space Station Freedom Utilization Conference 1992 p 41-45 (For primary document see N93-22606 08-18)

Avail: CASI HC A01/MF A04

NASA field centers and contractors are organized to develop 'work packages' for Space Station Freedom. Marshall Space Flight Center and Boeing are building the U.S. laboratory and habitation modules, nodes, and environmental control and life support system; Johnson Space Center

and McDonnell Douglas are responsible for truss structure, data management, propulsion systems, thermal control, and communications and guidance; Lewis Research Center and Rocketdyne are developing the power system. The Canadian Space Agency (CSA) is contributing a Mobile Servicing Center, Special Dextrous Manipulator, and Mobile Servicing Center Maintenance Depot. The National Space Development Agency of Japan (NASDA) is contributing a Japanese Experiment Module (JEM), which includes a pressurized module, logistics module, and exposed experiment facility. The European Space Agency (ESA) is contributing the Columbus laboratory module. NASA ground facilities, now in various stages of development to support Space Station Freedom, include: Marshall Space Flight Center's Payload Operations Integration Center and Payload Training Complex (Alabama), Johnson Space Center's Space Station Control Center and Space Station Training Facility (Texas), Lewis Research Center's Power System Facility (Ohio), and Kennedy Space Center's Space Station Processing Facility (Florida). Budget appropriations impact the development of the Space Station. In Fiscal Year 1988, Congress appropriated only half of the funds that NASA requested for the space station program ($393 million vs. $767 million). In FY 89, NASA sought $967 million for the program, and Congress appropriated $900 million. NASA's FY 90 request was $2.05 billion compared to an appropriation of $1.75 billion; the FY 91 request was $2.45 billion, and the appropriation was $1.9 billion. After NASA restructured the Space Station Freedom program in response to directions from Congress, the agency's full budget request of $2.029 billion for Space Station Freedom in FY 92 was appropriated. For FY 93, NASA is seeking $2.25 billion for the program; the planned budget for FY 94 is $2.5 billion. Further alterations to the hardware configuration for Freedom would be a serious setback; NASA intends 'to stick with the current baseline' and continue planning for utilization. Author

N93-22609*# National Aeronautics and Space Administration, Washington, DC.

SPACE STATION FREEDOM RESEARCH CAPABILITIES

Robert Moorehead *In its* Space Station Freedom Utilization Conference 1992 p 47-59 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

NASA's plan for enhancing space-based research capabilities begins with extended-duration Space Shuttle missions that will double the research capability currently provided by Spacelab and culminate in Space Station Freedom. The 14-day USML 1 mission flown on the Space Shuttle in June 1992 was a space station precursor mission, dedicated to microgravity and life science research. Freedom will be a permanent space-based research facility, providing a working environment nearly free of buoyancy-driven convection, sedimentation, and hydrostatic pressure and featuring access to the ultra-high vacuum of space (for external payloads). In its crew-tended phase, Space Station Freedom will provide 40 times Spacelab's capability, and in its permanently occupied phase, Freedom will provide 110 times Spacelab's capability. (The Russian space station, Mir, offers 26 times Spacelab's capabilities.) According to NASA's current schedule, the first launch of a space station element will take place in November 1995, with permanently occupied capability planned for September 1999. This year, NASA will conduct space station critical design reviews (CDR's). Work package design reviews will take place from February to April 1993, followed by a systems CDR. Author

N93-22610*# National Aeronautics and Space Administration, Washington, DC.

OPPORTUNITIES FOR RESEARCH ON SPACE STATION FREEDOM

Robert W. Phillips *In its* Space Station Freedom Utilization Conference 1992 p 61-71 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

NASA has allocated research accommodations on Freedom (equipment, utilities, etc.) to the program offices that sponsor space-based research and development as follows: Space Science and Applications (OSSA)--52 percent, Commercial Programs (OCP)--28 percent, Aeronautics and Space Technology (OAST)--12 percent, and Space Flight (OSF)--8 percent. Most of OSSA's allocation will be used for microgravity and life science experiments; although OSSA's space physics, astrophysics, earth science and applications, and solar system exploration divisions also will use some of this allocation. Other Federal agencies have expressed an interest in using Space Station Freedom. They include the National Institutes of Health (NIH), U.S. Geological Survey, National Science Foundation, National Oceanic and Atmospheric Administration, and U.S. Departments of Agriculture and Energy. Payload interfaces with space station lab support equipment must be simple, and experiment packages must be highly contained. Freedom's research facilities will feature International Standard Payload Racks (ISPR's), experiment racks that are about twice the size of a Spacelab rack. ESA's Columbus lab will feature 20 racks, the U.S. lab will have 12 racks, and the Japanese lab will have 10. Thus, Freedom will have a total of 42 racks versus 8 for Space lab. NASA is considering outfitting some rack space to accommodate small, self-contained payloads similar to the Get-Away-Special canisters and middeck-locker experiment packages flown on Space Shuttle missions. Crew time allotted to experiments on Freedom at permanently occupied capability will average 25 minutes per rack per day, compared to six hours per rack per day on Spacelab missions. Hence, telescience--the remote operation of space-based experiments by researchers on the ground--will play a very important role in space station research. Plans for supporting life sciences research on Freedom focus on the two basic goals of NASA 's space life sciences program: to ensure the health, safety, and productivity of humans in space and to acquire fundamental knowledge of biological processes. Space-based research has already shown that people and plants respond the same way to the microgravity environment: they lose structure. However, the mechanisms by which they respond are different, and researchers do not yet know much about these mechanisms. Life science research accommodations on Freedom will include facilities for experiments designed to address this and other questions, in fields such as gravitational biology, space physiology, and biomedical monitoring and countermeasures research. Author

N93-22611*# National Aeronautics and Space Administration, Washington, DC.

HOW TO GET ON BOARD SPACE STATION FREEDOM

John-David Bartoe *In its* Space Station Freedom Utilization Conference 1992 p 73-94 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

Space Station Freedom will accommodate researchers with interests in science, technology and commercial applications. NASA sponsors will be responsible for selecting the U.S. researchers for Space Station Freedom. The four NASA sponsors are: Office of Space Science and Applications (OSSA), Office of Aeronautics and Space Technology (OAST), Office of Commercial Programs (OCP), and the Office of Space Flight (OSF). The areas of research responsibility for each sponsor are presented. The researcher solicitation vehicles used by OSSA and OAST and the methodology for researchers seeking sponsorship from OCP and OSF as well as the pricing policy are discussed. Descriptions of flight planning, payload integration and operations functions are presented. Three categories of payloads and their respective payload integration times are discussed. Researchers are advised to contact a NASA sponsor and a source which lists the points of contact for the NASA sponsors is noted. Author

N93-22612*# National Aeronautics and Space Administration, Washington, DC.

NASA'S COMMERCIAL RESEARCH PLANS AND OPPORTUNITIES

Ray J. Arnold *In its* Space Station Freedom Utilization Conference 1992 p 97-111 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

One of the primary goals of the National Aeronautics and Space Administration's (NASA) commercial space development plan is to encourage the development of space-based products and markets, along with the infrastructure and transportation that will support those products and markets. A three phased program has been instituted to carry out this program. The first phase utilizes government grants through the Centers for the Commercial Development of Space (CCDS) for space-related, industry driven research; the development of a technology data base; and the development of commercial space transportation and infrastructure. The second phase includes the development of these technologies by industry for new commercial markets, and features unique industry/government collaborations such as Joint Endeavor Agreements. The final phase will feature technical applications actually brought to the marketplace. The government's role will be to support industry required infrastructure to encourage start-up markets and industries through follow-on development agreements such as the Space Systems Development Agreement. The Office of Commercial Programs has an aggressive flight program underway on the Space Shuttle,

suborbital rockets, orbital expendable launch vehicles, and the Commercial Middeck Accommodation Module with SPACEHAB Inc. The Office of Commercial Program's has been allocated 35 percent of the U.S. share of the Space Station Freedom resources for 1997 utilization. A utilization plan has been developed with the Centers for the Commercial Development of Space and has identified eleven materials processing and biotechnology payloads occupying 5 double racks in the pressurized module as well as two payloads external to the module in materials exposure and environment monitoring. The Office of Commercial Programs will rely on the Space Station Freedom to provide the long duration laboratory component for space-based commercial research. Author

N93-22613*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SPACE TECHNOLOGY RESEARCH PLANS

W. Ray Hook *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 113-128 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

Development of new technologies is the primary purpose of the Office of Aeronautics and Space Technology (OAST). OAST's mission includes the following two goals: (1) to conduct research to provide fundamental understanding, develop advanced technology and promote technology transfer to assure U.S. preeminence in aeronautics and to enhance and/or enable future civil space missions: and (2) to provide unique facilities and technical expertise to support national aerospace needs. OAST includes both NASA Headquarters operations as well as programmatic and institutional management of the Ames Research Center, the Langley Research Center and the Lewis Research Center. In addition. a considerable portion of OAST's Space R&T Program is conducted through the flight and science program field centers of NASA. Within OAST, the Space Technology Directorate is responsible for the planning and implementation of the NASA Space Research and Technology Program. The Space Technology Directorate's mission is 'to assure that OAST shall provide technology for future civil space missions and provide a base of research and technology capabilities to serve all national space goals.' Accomplishing this mission entails the following objectives: y Identify, develop, validate and transfer technology to: (1) increase mission safety and reliability; (2) reduce flight program development and operations costs; (3) enhance mission performance; and (4) enable new missions. Provide the capability to: (1) advance technology in critical disciplines; and (2) respond to unanticipated mission needs. In-space experiments are an integral part of OAST's program and provides for experimental studies, development and support for in-space flight research and validation of advanced space technologies. Conducting technology experiments in space is a valuable and cost effective way to introduce advanced' technologies into flight programs. These flight experiments support both the R&T base and the focussed programs within OAST. Author

N93-22614*# National Aeronautics and Space Administration, Washington, DC.

OSSA SPACE STATION FREEDOM SCIENCE UTILIZATION PLANS

Philip J. Cressy *In its* Space Station Freedom Utilization Conference 1992 p 129-135 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

Long duration exposure to an essentially zero-gravity environment is a phenomenon exclusive to the Space Station Freedom that cannot be duplicated on Earth. The Freedom Station will offer periods of time on orbit extending to weeks and months rather than hours or days, allowing for in-depth space based research and analysis to a degree never before achieved. OSSA remains committed to exploiting the unique capabilities provided by the Space Station as well as other space-based facilities to study the nature of physical, chemical, and biological processes in a low-gravity environment and to apply these studies to advance science and applications in such fields as biomedical research, plant and animal physiology, exobiology, biotechnology, materials science, fluid physics, and combustion science. The OSSA focus is on progressive science investigations, many requiring hands-on scientist involvement using sophisticated experiment hardware. OSSA science utilization planning for the Freedom Station is firmly established. For this presentation, this planning is discussed in three general areas: OSSA goals and overall approach, the current and on-going program, and plans for space station utilization. In the first area, OSSA addresses its overall approach to space science research, its commitment to transition to Space Station Freedom, and its top-level strategy for the utilization of Freedom. The current and on-going program is next discussed, focusing on the various Spacelab series of missions which are providing the stepping-stones to Space Station Freedom. Selected science results from SLS-1 and USML-1 are cited which underline the value of properly outfitted laboratories in space in which crew-intensive experiment interactions are possible. The presentation is concluded with a discussion of top-level goals and strategies for utilizing the Freedom Station by OSSA's Life Sciences Division and its Microgravity Science and Applications Division. Author

N93-22615*# Alabama Univ., Birmingham. Center for Macromolecular Crystallography.

COMMERCIAL RESEARCHER PERSPECTIVE

Larry DeLucas *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 137-145 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

Protein crystallography--a research tool used to study the structure of the complex building blocks of living systems--has a lot to gain from space-based research. In order to know how a protein works in the human body, researchers must understand its molecular structure. Researchers have identified 150,000 different proteins in the body, but they now know the structure of less than a third of them. The only viable technique for analyzing the structure of these proteins is x-ray diffraction of the proteins in their crystal form. The better the quality of a protein crystal, the more useful it is to researchers who are trying to delineate its structure. The microgravity environment of space allows protein crystals to grow nearly undisturbed by convection and other gravity-driven forces that cause flaws to form in them on the ground. In space, lack of convection enables protein crystals to grow more slowly than they do on Earth, and the slower a protein crystal grows, the fewer flaws it will have. Protein crystal growth experiments have already flown on 14 Space Shuttle missions. This year's USML-1 Spacelab mission included protein crystal growth experiments conducted for commercial researchers. The results of protein crystal experiments flown thus far have been larger crystals with more uniform morphologies. The Center for Macromolecular Crystallography (A NASA-cosponsored CCDS) currently builds flight hardware to meet researchers' needs and handles sample loading and retrieval for flight experiments. Protein crystallography enables 'rational drug design': the development of drugs that bind only with the target protein and, hence, do not cause side effects. For example, pharmaceutical companies presently are interested in developing drugs that can inhibit purine nucleoside phosphorylase (PNP), a protein that plays a role in auto-immune diseases. To continue these kinds of investigations, researchers need a constant supply of protein crystals that are as free of flaws as possible. Space Station Freedom will provide the kind of research environment that will enable the production of such supplies. In addition, Freedom will provide the kind of long-duration facility required by protein crystal researchers: 40 percent of proteins require more than two weeks to crystallize. Author

N93-22616*# National Space Development Agency, Tokyo (Japan).

JAPANESE PLAN FOR SSF UTILIZATION

Toshio Mizuno *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 147-164 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

The Japanese Experiment Module (JEM) program has made significant progress. The JEM preliminary design review was completed in July 1992; construction of JEM operation facilities has begun; and the micro-G airplane, drop shaft, and micro-G experiment rocket are all operational. The national policy for JEM utilization was also established. The Space Experiment Laboratory (SEL) opened in June '92 and will function as a user support center. Eight JEM multiuser facilities are in phase B, and scientific requirements are being defined for 17 candidate multiuser facilities. The National Joint Research Program is about to start. Precursor missions and early Space Station utilization activities are being defined. This paper summarizes the program in outline and graphic form. Author (revised)

N93-22617*# Canadian Space Agency, Ottawa (Ontario).
CANADIAN SPACE AGENCY SPACE STATION FREEDOM UTILIZATION PLANS
James Faulkner and Ron Wilkinson *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 165-173 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

Under the terms of the NASA/CSA Memorandum of Understanding, Canada will contribute the Mobile Servicing System and be entitled to use 3 percent of all Space Station utilization resources and user accommodations over the 30 year life of the Station. Equally importantly Canada, like NASA, can begin to exploit these benefits as soon as the Man-Tended Capability (MTC) phase begins, in early 1997. Canada has been preparing its scientific community to fully utilize the Space Station for the past five years; most specifically by encouraging, and providing funding, in the area of Materials Science and Applications, and in the area of Space Life Sciences. The goal has been to develop potential applications and an experienced and proficient Canadian community able to effectively utilize microgravity environment facilities such as Space Station Freedom. In addition, CSA is currently supporting four facilities; a Laser Test System, a Large Motion Isolation Mount, a Canadian Float Zone Furnace, and a Canadian Protein Crystallization Apparatus. In late April of this year CSA sent out a Solicitation of Interest (SOI) to potential Canadian user from universities, industry, and government. The intent of the SOI was to determine who was interested, and the type of payloads which the community at large intended to propose. The SOI will be followed by the release of an Announcement of Opportunity (AO) following governmental approval of the Long Term Space plan later this year, or early next year. Responses to the AO will be evaluated and prioritized in a fair and impartial payload selection process, within the guidelines set by our international partners and the Canadian Government. Payload selection is relatively simple compared to the development and qualification process. An end-to-end user support program is therefore also being defined. Much of this support will be provided at the new headquarters currently being built in St. Hubert, Quebec. It is recognized that utilizing the Space Station could be expensive for users; costing in many cases millions of dollars to get a payload from conception to retrieval. It is also recognized that some of the potential users cannot or will not invest a lot of money or effort into Space Station utilization, unless there is a perceived significant commercial potential. How best to fund Space Station payloads is under study. Space Station Freedom will provide the first opportunity for Canada to conduct experiments in a long-duration microgravity environment. CSA have been developing and funding potential users for some time, and considerable interest has been shown by the response to our SOI earlier this year. Canada can be one of the two earliest users for the Space Station, along with NASA. We hope to take full advantage of this opportunity. Author

N93-22618*# European Space Agency, Paris (France). Microgravity and Columbus Utilisation Dept.
EUROPEAN RESEARCH PLANS
Jean-Jacques Dordain *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 175-177 (For primary document see N93-22606 08-18)
Avail: CASI HC A01/MF A04

The text of a short speech describing the European plans for utilization of Space Station Freedom is presented. In particular, the capabilities and utilization of the Columbus module are discussed. CASI

N93-22619*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE LIFE SCIENCES PERSPECTIVES FOR SPACE STATION FREEDOM
Laurence R. Young *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 179-185 Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

It is now generally acknowledged that the life science discipline will be the primary beneficiary of Space Station Freedom. The unique facility will permit advances in understanding the consequences of long duration exposure to weightlessness and evaluation of the effectiveness of countermeasures. It will also provide an unprecedented opportunity for basic gravitational biology, on plants and animals as well as human subjects. The major advantages of SSF are the long duration exposure and the availability of sufficient crew to serve as subjects and operators. In order to fully benefit from the SSF, life sciences will need both sufficient crew time and communication abilities. Unlike many physical science experiments, the life science investigations are largely exploratory, and frequently bring unexpected results and opportunities for study of newly discovered phenomena. They are typically crew-time intensive, and require a high degree of specialized training to be able to react in real time to various unexpected problems or potentially exciting findings. Because of the long duration tours and the large number of experiments, it will be more difficult than with Spacelab to maintain astronaut proficiency on all experiments. This places more of a burden on adequate communication and data links to the ground, and suggests the use of AI expert system technology to assist in astronaut management of the experiment. Typical life science experiments, including those flown on Spacelab Life Sciences 1, will be described from the point of view of the demands on the astronaut. A new expert system, 'PI in a Box,' will be introduced for SLS-2, and its applicability to other SSF experiments discussed. (This paper consists on an abstract and ten viewgraphs.) Author (revised)

N93-22620*# Clarkson Univ., Potsdam, NY. International Center for Gravity Materials Science and Applications.
RESEARCH EXPERIENCES ON MATERIALS SCIENCE IN SPACE ABOARD SALYUT AND MIR
Liya L. Regel *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 187-204 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

From 1980 through 1991 approximately 500 materials processing experiments were performed aboard the space stations Salyut 6, Salyut 7 and Mir. This includes work on catalysts, polymers, metals and alloys, optical materials, superconductors, electronic crystals, thin film semiconductors, super ionic crystals, ceramics, and protein crystals. Often the resulting materials were surprisingly superior to those prepared on earth. The Soviets were the first to fabricate a laser (CdS) from a crystal grown in space, the first to grow a heterostructure in space, the first super ionic crystal in space, the first crystals of CdTe and its alloys, the first zeolite crystals, the first protein crystals, the first chromium disilicide glass, etc. The results were used to optimize terrestrial materials processing operations in Soviet industry. The characteristics of these three space stations are reviewed, along with the advantages of a space station for materials research, and the problems encountered by the materials scientists who used them. For example, the stations and the materials processing equipment were designed without significant input from the scientific community that would be using them. It is pointed out that successful results have been achieved also by materials processing at high gravity in large centrifuges. This research is also continuing around the world, including at Clarkson University. It is recommended that experiments be conducted in centrifuges in space, in order to investigate the acceleration regime between earth's gravity and the microgravity achieved in orbiting space stations. One cannot expect to understand the influence of gravity on materials processing from only two data points, earth's gravity and microgravity. One must also understand the influence of fluctuations in acceleration on board space stations, the so-called 'g-jitter.' This paper is presented in outline and graphical form. Author (revised)

N93-22621*# National Aeronautics and Space Administration, Washington, DC.
REMARKS BY NASA ADMINISTRATOR DANIEL S. GOLDIN **c12**
Daniel S. Goldin *In its* Space Station Freedom Utilization Conference 1992 p 205-207 (For primary document see N93-22606 08-18)
Avail: CASI HC A01/MF A04

The text of a brief speech addressing the technical and social benefits of Space Station Freedom is presented. CASI

N93-22622*# National Aeronautics and Space Administration, Washington, DC.
LIFE SCIENCES UTILIZATION OF SPACE STATION FREEDOM **c51**
Lawrence P. Chambers *In its* Space Station Freedom Utilization Conference 1992 p 211-220 (For primary document see N93-22606

08-18)
Avail: CASI HC A02/MF A04

Space Station Freedom will provide the United States' first permanently manned laboratory in space. It will allow, for the first time, long term systematic life sciences investigations in microgravity. This presentation provides a top-level overview of the planned utilization of Space Station Freedom by NASA's Life Sciences Division. The historical drivers for conducting life sciences research on a permanently manned laboratory in space as well as the advantages that a space station platform provides for life sciences research are discussed. This background information leads into a description of NASA's strategy for having a fully operational International Life Sciences Research Facility by the year 2000. Achieving this capability requires the development of the five discipline focused 'common core' facilities. Once developed, these facilities will be brought to the space station during the Man-Tended Capability phase, checked out and brought into operation. Their delivery must be integrated with the Space Station Freedom manifest. At the beginning of Permanent Manned Capability, the infrastructure is expected to be completed and the Life Sciences Division's SSF Program will become fully operational. A brief facility description, anticipated launch date and a focused objective is provided for each of the life sciences facilities, including the Biomedical Monitoring and Countermeasures (BMAC) Facility, Gravitational Biology Facility (GBF), Gas Grain Simulation Facility (GGSF), Centrifuge Facility (CF), and Controlled Ecological Life Support System (CELSS) Test Facility. In addition, hardware developed by other NASA organizations and the SSF International Partners for an International Life Sciences Research Facility is also discussed. Author (revised)

N93-22623*# National Aeronautics and Space Administration, Washington, DC.

LIFE SCIENCES RECRUITMENT OBJECTIVES **c51**

J. Richard Keefe *In its* Space Station Freedom Utilization Conference 1992 p 221-233 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

The goals of the Life Sciences Division of the Office of Space Sciences and Application are to ensure the health, well being and productivity of humans in space and to acquire fundamental scientific knowledge in space life sciences. With these goals in mind Space Station Freedom represents substantial opportunities and significant challenges to the Life Sciences Division. For the first time it will be possible to replicate experimental data from a variety of simultaneously exposed species with appropriate controls and real-time analytical capabilities over extended periods of time. At the same time, a system for monitoring and ameliorating the physiological adaptations that occur in humans subjected to extended space flight must be evolved to provide the continuing operational support to the SSF crew. To meet its goals, and take advantage of the opportunities and overcome the challenges presented by Space Station Freedom, the Life Sciences Division is developing a suite of discipline-focused sequence. The research phase of the Life Sciences Space Station Freedom Program will commence with the utilization flights following the deployment of the U.S. laboratory module and achievement of Man Tended Capability. Investigators that want the Life Sciences Division to sponsor their experiment on SSF can do so in one of three ways: submitting a proposal in response to a NASA Research Announcement (NRA), submitting a proposal in response to an Announcement of Opportunity (AO), or submitting an unsolicited proposal. The scientific merit of all proposals will be evaluated by peer review panels. Proposals will also be evaluated based on relevance to NASA's missions and on the results of an Engineering and Cost Analyses. The Life Sciences Division expects that the majority of its funding opportunities will be announced through NRA's. It is anticipated that the first NRA will be released approximately three years before first element launch (currently scheduled for late 1995). Subsequent NRA's will be released on a rotating two year cycle. Author

N93-22624*# National Aeronautics and Space Administration, Washington, DC.

BIOMEDICAL MONITORING AND COUNTERMEASURES FACILITY **c51**

Donald F. Stewart *In its* Space Station Freedom Utilization Conference 1992 p 235-249 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

The Space Station Freedom Program (SSFP) represents the transition within the US Space program from the 'heroic' era of space flight (characterized most vividly by the Mercury and Apollo programs) to an epoch characterized by routine access to the space environment. In this new era, the unique characteristics of the microgravity environment will enable new types of research activities, primarily in the life sciences, materials science, and biotechnology fields. In addition to its role as a'microgravity science laboratory,' Space Station Freedom (SSF) constitutes the operational platform on which the knowledge and skills needed to continue our exploration of space will be acquired. In the area of spacecraft operations, these skills include the ability to assemble, operate, and maintain large structures in space. In the area of crew operations, the potentially harmful effects of extended exposure to microgravity must be understood in order to keep the crew mission capable. To achieve this goal, the complex process of physiological deconditioning must be monitored, and countermeasures utilized as needed to keep the individual crew members within acceptable physiological limits. The countermeasures program under development for the SSF Program is titled the Biomedical Monitoring and Countermeasures (BMAC) program. As implied by the name, this activity has two primary products, a biomedical monitoring element and a countermeasures development effort. The program is a critical path element in the overall SSF Program, and should be considered an essential element of operations on board the space station. It is readily apparent that the capability to both protect and optimize the health and performance of the human operators on board SSF will be a critical element in the overall success of the SSFP. Previous experience within the Russian space program has demonstrated that the time required for countermeasures on extended missions can become a monumental operational burden. Therefore, one of the primary objectives of the countermeasures development activity will be to design and implement countermeasures which are significantly more effective than the existing generation. Other primary objectives include the following: to set health and human performance standards for all mission phases; to determine critical issues that affect performance or return to flight status; to develop and implement monitoring systems to follow health and performance status; and to understand risk, and balance the resource costs of countermeasures vs. the benefit gained. Author (revised)

N93-22625*# General Electric Co., Huntsville, AL. Government Services.

GRAVITATIONAL BIOLOGY FACILITY ON SPACE STATION: MEETING THE NEEDS OF SPACE BIOLOGY **c51**

Katherine Allen and Charles Wade *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 251-259 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

The Gravitational Biology Facility (GBF) is a set of generic laboratory equipment needed to conduct research on Space Station Freedom (SSF), focusing on Space Biology Program science (Cell and Developmental Biology and Plant Biology). The GBF will be functional from the earliest utilization flights through the permanent manned phase. Gravitational biology research will also make use of other Life Sciences equipment on the space station as well as existing equipment developed for the space shuttle. The facility equipment will be developed based on requirements derived from experiments proposed by the scientific community to address critical questions in the Space Biology Program. This requires that the facility have the ability to house a wide variety of species, various methods of observation, and numerous methods of sample collection, preservation, and storage. The selection of the equipment will be done by the members of a scientific working group (5 members representing cell biology, 6 developmental biology, and 6 plant biology) who also provide requirements to design engineers to ensure that the equipment will meet scientific needs. All equipment will undergo extensive ground based experimental validation studies by various investigators addressing a variety of experimental questions. Equipment will be designed to be adaptable to other space platforms. The theme of the Gravitational Biology Facility effort is to provide optimal and reliable equipment to answer the critical questions in Space Biology as to the effects of gravity on living systems. Author (revised)

N93-22626*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

GAS-GRAIN SIMULATION FACILITY (GGSF) **c29**

Ken Greenwald *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 261-274 (For primary document see N93-22606

08-18)
Avail: CASI HC A03/MF A04

The goal of the Gas-Grain Simulation Facility project is to provide a microgravity laboratory to facilitate research relevant to exobiology (the study of the origin and evolution of life in the universe). Such a facility will also be useful in other areas of study important to NASA including planetary science, biology, atmospheric science, astrophysics, chemistry, and physics. To achieve this goal, the project will develop and support the GGSF, a modular facility-class payload planned for inclusion on Space Station Freedom. The GGSF will consist of the following: an experiment chamber(s) supported by subsystems that provide chamber environment regulation and monitoring capabilities; sample generation, injection, positioning, and retrieval capabilities; and computer control, data acquisition, and housekeeping capabilities. The facility will also provide analytical tools such as light-scattering measurement systems, aerosol size-spectrum measurement devices, and optical imaging systems. Author (revised)

N93-22627*# General Electric Co., Huntsville, AL. Government Services.

RESEARCH OPPORTUNITIES WITH THE CENTRIFUGE FACILITY

Glenn A. Funk *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 275-281 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

The Centrifuge Facility on Space Station Freedom will consist of a 2.5-meter diameter Centrifuge accommodating two concentric rings of habitats and providing variable g-forces between 0.01 g and 2.0 g; modular habitats providing housing and lifesupport for rats, mice, and plants; a habitat holding system providing power, water, airflow and other utilities to several modular habitats; and a life sciences glovebox, an isolated work volume accommodating simultaneous operations by at least two scientists and providing lighting, airflow, video and data access, and other experiment support functions. The centrifuge facility will enable long-duration animal and plant microgravity research not previously possible in the NASA flight research program. It will offer unprecedented opportunities for use of on-board 1-g control populations and statistically significant numbers of specimens. On orbit 1-g controls will allow separation of the effects of microgravity from other environmental factors. Its selectable-g and simultaneous multiple-g capabilities will enable studies of gravitational thresholds, the use of artificial gravity as a countermeasure to the effects of microgravity, and ready simulation of Lunar and Martian gravities.
Author (revised)

N93-22628*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CLOSED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS) TEST FACILITY **c54**

Robert D. MacElroy *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 283-290 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

The CELSS Test Facility (CTF) is being developed for installation on Space Station Freedom (SSF) in August 1999. It is designed to conduct experiments that will determine the effects of microgravity on the productivity of higher (crop) plants. The CTF will occupy two standard SSF racks and will accommodate approximately one square meter of growing area and a canopy height of 80 cm. The growth volume will be isolated from the external environment, allowing stringent control of environmental conditions. Temperature, humidity, oxygen, carbon dioxide, and light levels will all be closely controlled to prescribed set points and monitored. This level of environmental control is needed to prevent stress and allow accurate assessment of microgravity effect (10-3 to 10-6 x g). Photosynthetic rates and respiration rates, calculated through continuous recording of gas concentrations, transpiration, and total and edible biomass produced will be measured. Toxic byproducts will be monitored and scrubbed. Transpiration water will be collected within the chamber and recycled into the nutrient solution. A wide variety of crop plants, e.g., wheat, soy beans, lettuce, potatoes, can be accommodated and various nutrient delivery systems and light delivery systems will be available. In the course of its development, the CTF will exploit fully, and contribute importantly, to the state-of-art in closed system technology and plant physiology. Author (revised)

N93-22629*# Omega Aerospace, Inc., Virginia Beach, VA.

AN ON-ORBIT VIEWPOINT OF LIFE SCIENCES RESEARCH Abstract Only **c51**

Byron K. Lichtenberg *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 291 (For primary document see N93-22606 08-18)
Avail: CASI HC A01/MF A04

As a Payload Specialist and a life science researcher, I want to present several issues that impact life science research in space. During early space station operations, life science and other experiments will be conducted in a time-critical manner and there will be the added duties of both space shuttle and space station systems operation (and the concomittent training overhead). Life sciences research is different from other science research done in space because the crew is involved both as an operator and as a subject. There is a need for pre- and post-flight data collection as well as in flight data collection. It is imperative that the life science researcher incorporate the crew members into their team early enough in the training cycle to fully explain the science and to make the crew aware of the importance and sensitivities of the experiment. During the pre-flight phase, the crew is incredibly busy with a myriad of duties. Therefore, it is difficult to get 'pristine' subjects for the baseline data collection. There are also circadian shifts, travel, and late nights to confound the data. During this time it is imperative that the researcher develop, along with the crew, a realistic estimate of crew-time required for their experiment. In flight issues that affect the researcher are the additional activities of the crew, the stresses inherent in space flight, and the difficulty of getting early in-flight data. During SSF activities, the first day or two will be taken up with rendezvous and docking. Other issues are the small number of subjects on any given flight, the importance of complete and concise procedures, and the vagaries of on-board data collection. Post flight, the crew is tired and experiences a 'relaxation.' This along with circadian shifts and rapid re-adaptation to 1-g make immediate post-flight data collection difficult. Finally, the blending of operational medicine and research can result in either competition for resources (crew time, etc.) or influence on the physiological state of the crew. However, the unique opportunity to conduct research in an environment that cannot be duplicated on Earth outweighs the 'challenges' that exist for space life researchers.
Author (revised)

N93-22630*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

CREW HEALTH **c52**

Roger D. Billica *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 293-299 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

Crew health concerns for Space Station Freedom are numerous due to medical hazards from isolation and confinement, internal and external environments, zero gravity effects, occupational exposures, and possible endogenous medical events. The operational crew health program will evolve from existing programs and from life sciences investigations aboard Space Station Freedom to include medical monitoring and certification, medical intervention, health maintenance and countermeasures, psychosocial support, and environmental health monitoring. The knowledge and experience gained regarding crew health issues and needs aboard Space Station Freedom will be used not only to verify requirements and programs for long duration space flight, but also in planning and preparation for Lunar and Mars exploration and colonization. Author (revised)

N93-22631*# Auburn Univ., AL. Space Power Inst.

SPACE STATION FREEDOM AS AN ENGINEERING EXPERIMENT STATION: AN OVERVIEW

M. Frank Rose *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 303-311 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

In this presentation, the premise that Space Station Freedom has great utility as an engineering experiment station will be explored. There are several modes in which it can be used for this purpose. The most obvious are space qualification, process development, in space satellite repair, and materials engineering. The range of engineering experiments which can be done at Space Station Freedom run the gamut from small

process oriented experiments to full exploratory development models. A sampling of typical engineering experiments are discussed in this session. First and foremost, Space Station Freedom is an elaborate experiment itself, which, if properly instrumented, will provide engineering guidelines for even larger structures which must surely be built if humankind is truly 'outward bound.' Secondly, there is the test, evaluation and space qualification of advanced electric thruster concepts, advanced power technology and protective coatings which must of necessity be tested in the vacuum of space. The current approach to testing these technologies is to do exhaustive laboratory simulation followed by shuttle or unmanned flights. Third, the advanced development models of life support systems intended for future space stations, manned mars missions, and lunar colonies can be tested for operation in a low gravity environment. Fourth, it will be necessary tc develop new protective coatings, establish construction techniques, evaluate new materials to be used in the upgrading and repair of Space Station Freedom. Finally, the industrial sector, if it is ever to build facilities for the production of commercial products, must have all the engineering aspects of the process evaluated in space prior to a commitment to such a facility. Author (revised)

N93-22632*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PRECURSOR SPACE STATION FREEDOM EXPERIMENTS

Roger A. Breckenridge *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 313-320 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

The NASA Office of Aeronautics and Space Technology uses the In-Space Technology Experiments Program (IN-STEP) as the primary management vehicle to pursue innovative and potentially high payoff space technology experiments. The purpose of this presentation is to provide an overview of the IN-STEP approach in developing precursor Space Station experiments; identify those experiments now in the program; review the key points of the IN-STEP 1992 Announcement of Opportunity; and describe the OAST in-space technology experiments development process. Author

N93-22633*# Massachusetts Inst. of Tech., Cambridge. Space Engineering Research Center.

PRECURSOR SSF UTILIZATION: THE MODE EXPERIMENTS

Edward F. Crawley *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 321-333 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

The MIT Space Engineering Research Center is the principal investigator for a series of experiments which utilize the Shuttle Middeck as an engineering dynamics laboratory. The first, which flew on STS-48 in Sep. 1991, was the Middeck O-gravity Dynamics Experiment (MODE). This experiment focused on the dynamics of a scaled deployable truss, similar to that of SSF, and contained liquids in tanks. MODE will be reflown in the fall of 1993. In mid-1994, the Middeck Active Control Experiment (MACE) will examine the issues associated with predicting and verifying the closed loop behavior of a controlled structure in zero gravity. The paper will present experiment background, planning, operational experience, results, and lessons learned from these experiments which are pertinent to SSF utilization. Author (revised)

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UTILIZATION OF SPACE STATION FREEDOM FOR TECHNOLOGY RESEARCH

Don E. Avery *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 335-347 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

Space Station Freedom presents a unique opportunity for technology developers to conduct research in the space environment. Research can be conducted in the pressurized volume of the Space Station's laboratories or attached to the Space Station truss in the vacuum of space. Technology developers, represented by the Office of Aeronautics and Space Technology (OAST), will have 12 percent of the available Space Station resources (volume, power, data, crew, etc.) to use for their research. Most technologies can benefit from research on Space Station Freedom and all these technologies are represented in the OAST proposed traffic model. This traffic model consists of experiments that have been proposed by technology developers but not necessarily selected for flight. Experiments to be flown in space will be selected through an Announcement of Opportunity (A.O.) process. The A.O. is expected to be released in August, 1992. Experiments will generally fall into one of the 3 following categories: (1) Individual technology experiments; (2) Instrumented Space Station; and (3) Guest investigator program. The individual technology experiments are those that do not instrument the Space Station nor directly relate to the development of technologies for evolution of Space Station or development of advanced space platforms. The Instrumented Space Station category is similar to the Orbiter Experiments Program and allows the technology developer to instrument subsystems on the Station or develop instrumentation packages that measure products or processes of the Space Station for the advancement of space platform technologies. The guest investigator program allows the user to request data from Space Station or other experiments for independent research. When developing an experiment, a developer should consider all the resources and infrastructure that Space Station Freedom can provide and take advantage of these to the maximum extent possible. Things like environment, accommodations, carriers, and integration should all be taken into account. In developing experiments at Langley Research Center, an iterative approach is proving useful. This approach uses Space Station utilization and subsystem experts to advise and critique experiment designs to take advantage of everything the Space Station has to offer. Also, solid object modeling and animation computer tools are used to fully visualize the experiment and its processes. This process is very useful for attached payloads and allows problems to be detected early in the experiment design phase. Author

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MODAL IDENTIFICATION EXPERIMENT

Raymond G. Kvaternik *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 349-362 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

The Modal Identification Experiment (MIE) is a proposed on-orbit experiment being developed by NASA's Office of Aeronautics and Space Technology wherein a series of vibration measurements would be made on various configurations of Space Station Freedom (SSF) during its on-orbit assembly phase. The experiment is to be conducted in conjunction with station reboost operations and consists of measuring the dynamic responses of the spacecraft produced by station-based attitude control system and reboost thrusters, recording and transmitting the data, and processing the data on the ground to identify the natural frequencies, damping factors, and shapes of significant vibratory modes. The experiment would likely be a part of the Space Station on-orbit verification. Basic research objectives of MIE are to evaluate and improve methods for analytically modeling large space structures, to develop techniques for performing in-space modal testing, and to validate candidate techniques for in-space modal identification. From an engineering point of view, MIE will provide the first opportunity to obtain vibration data for the fully-assembled structure because SSF is too large and too flexible to be tested as a single unit on the ground. Such full-system data is essential for validating the analytical model of SSF which would be used in any engineering efforts associated with structural or control system changes that might be made to the station as missions evolve over time. Extensive analytical simulations of on-orbit tests, as well exploratory laboratory simulations using small-scale models, have been conducted in-house and under contract to develop a measurement plan and evaluate its potential performance. In particular, performance trade and parametric studies conducted as part of these simulations were used to resolve issues related to the number and location of the measurements, the type of excitation, data acquisition and data processing, effects of noise and nonlinearities, selection of target vibration modes, and the appropriate type of data analysis scheme. The purpose of this talk is to provide an executive-summary-type overview of the modal identification experiment which has emerged from the conceptual design studies conducted to-date. Emphasis throughout is on those aspects of the experiment which should be of interest to those attending the subject utilization conference. The presentation begins with some preparatory remarks to provide background and motivation for the experiment, describe

the experiment in general terms, and cite the specific technical objectives. This is followed by a summary of the major results of the conceptual design studies conducted to define the baseline experiment. The baseline experiment which has resulted from the studies is then described. Author

N93-22636*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SELECTED OAST/OSSA SPACE EXPERIMENT ACTIVITIES IN SUPPORT OF SPACE STATION FREEDOM

Richard DeLombard *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 363-371 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

The Space Experiments Division at NASA Lewis Research Center is developing technology and science space experiments for the Office of Aeronautics and Space Technology (OAST) and the Office of Space Sciences and Applications (OSSA). Selected precursor experiments and technology development activities supporting the Space Station Freedom (SSF) are presented. The Tank Pressure Control Experiment (TPCE) is an OAST-funded cryogenic fluid dynamics experiment, the objective of which is to determine the effectiveness of jet mixing as a means of equilibrating fluid temperatures and controlling tank pressures, thereby permitting the design of lighter cryogenic tanks. The information from experiments such as this will be utilized in the design and operation of on board cryogenic storage for programs such as SSF. The Thermal Energy Storage Flight Project (TES) is an OAST-funded thermal management experiment involving phase change materials for thermal energy storage. The objective of this project is to develop and fly in-space experiments to characterize void shape and location in phase change materials used in a thermal energy storage configuration representative of an advanced solar dynamic system design. The information from experiments such as this will be utilized in the design of future solar dynamic power systems. The Solar Array Module Plasma Interaction Experiment (SAMPIE) is an OAST-funded experiment to determine the environmental effects of the low earth orbit (LEO) space plasma environment on state-of-the-art solar cell modules biased to high potentials relative to the plasma. Future spacecraft designs and structures will push the operating limits of solar cell arrays and other high voltage systems. SAMPIE will provide key information necessary for optimum module design and construction. The Vibration Isolation Technology (VIT) Advanced Technology Development effort is funded by OSSA to provide technology necessary to maintain a stable microgravity environment for sensitive payloads on board spacecraft. The proof of concept will be demonstrated by laboratory tests and in low-gravity aircraft flights. VIT is expected to be utilized by many SSF microgravity science payloads. The Space Acceleration Measurement System (SAMS) is an OSSA-funded instrument to measure the microgravity acceleration environment for OSSA payloads on the shuttle and SSF. Author

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SPACECRAFT MATERIALS AND COATINGS EXPERIMENTS

Wayne S. Slemp *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 373-378 (For primary document see N93-22606 08-18)

Avail: CASI HC A01/MF A04

The 5.8-year exposure data from the Long Duration Experiment Facility (LDEF) has demonstrated the benefits of long-term exposure in low Earth orbit (LEO) for understanding the behavior of spacecraft materials and coatings for use in extended space missions. The Space Station Freedom represents the next large area spacecraft available in NASA planned missions for obtaining this long term space exposure data. The advantages of using the Space Station Freedom for these studies are presented. Discrepancies between short-term flight exposure result from Shuttle Orbiter experiments and the long-term LDEF results are shown. The major objectives and benefits of conducting materials and coatings experiments on Space Station Freedom are emphasized. Author

N93-22638*# Case Western Reserve Univ., Cleveland, OH. Center on Materials for Space Structures.

LONG DURATION SPACE MATERIALS EXPOSURE (LDSE)

David Allen and Robert Schmidt *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 379-393 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

The Center on Materials for Space Structures (CMSS) at Case Western Reserve University is one of seventeen Commercial Centers for the Development of Space. It was founded to: (1) produce and evaluate materials for space structures; (2) develop passive and active facilities for materials exposure and analysis in space; and (3) develop improved material systems for space structures. A major active facility for materials exposure is proposed to be mounted on the exterior truss of the Space Station Freedom (SSF). This Long Duration Space Materials Exposure (LDSE) experiment will be an approximately 6 1/2 ft. x 4 ft. panel facing into the velocity vector (RAM) to provide long term exposure (up to 30 years) to atomic oxygen, UV, micro meteorites, and other low earth orbit effects. It can expose large or small active (instrumented) or passive samples. These samples may be mounted in a removable Materials Flight Experiment (MFLEX) carrier which may be periodically brought into the SSF for examination by CMSS's other SSF facility, the Space Materials Evaluation Facility (SMEF), which will contain a Scanning Electron Microscope, a Variable Angle & Scanning Ellipsometer, a Fourier Transform Infrared Spectrometer, and other analysis equipment. These facilities will allow commercial firms to test their materials in space and promptly obtain information on their materials survivability in the LEO environment. Author

N93-22639*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

POTENTIAL PRESSURIZED PAYLOADS: FLUID AND THERMAL EXPERIMENTS

Theodore D. Swanson *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 395-406 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

Space Station Freedom (SSF) presents the opportunity to perform long term fluid and thermal experiments in a microgravity environment. This presentation provides perspective on the need for fluids/thermal experimentation in a microgravity environment, addresses previous efforts, identifies possible experiments, and discusses the capabilities of a proposed fluid physics/dynamics test facility. Numerous spacecraft systems use fluids for their operation. Thermal control, propulsion, waste management, and various operational processes are examples of such systems. However, effective ground testing is very difficult. This is because the effect of gravity induced phenomena, such as hydrostatic pressure, buoyant convection, and stratification, overcome such forces as surface tension, diffusion, electric potential, etc., which normally dominate in a microgravity environment. Hence, space experimentation is necessary to develop and validate a new fluid based technology. Two broad types of experiments may be performed on SSF: basic research and applied research. Basic research might include experiments focusing on capillary phenomena (with or without thermal and/or solutal gradients), thermal/solutal convection, phase transitions, and multiphase flow. Representative examples of applied research might include two-phase pressure drop, two-phase flow instabilities, heat transfer coefficients, fluid tank fill/drain, tank slosh dynamics, condensate removal enhancement, and void formation within thermal energy storage materials. In order to better support such fluid/thermal experiments on board SSF, OSSA has developed a conceptual design for a proposed Fluid Physics/Dynamics Facility (FP/DF). The proposed facility consists of one facility rack permanently located on SSF and one experimenter rack which is changed out as needed to support specific experiments. This approach will minimize the on-board integration/deintegration required for specific experiments. The FP/DF will have acceleration/vibration compensation, power and thermal interfaces, computer command/data collection, a video imaging system, and a portable glove box for operations. This facility will allow real-time astronaut interaction with the testing.

Author

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ZERO-G LIFE SUPPORT FOR SPACE STATION FREEDOM **c54**

Matthew Kolodney (Lockheed Engineering and Sciences Co., Houston, TX.) and L. Dall-Bauman *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 407-414 (For primary document see

N93-22606 08-18)
Avail: CASI HC A02/MF A04

Optimal design of spacecraft environmental control and life support systems (ECLSS) for long duration missions requires an understanding of microgravity and its long-term influence on ECLSS performance characteristics. This understanding will require examination of the fundamental processes associated with air revitalization and water recovery in a microgravity environment. Short term testing can be performed on NASA's reduced gravity aircraft (a KC-135), but longer tests will need to be conducted on the shuttle or Space Station Freedom. Conceptual designs have been prepared for ECLSS test beds that will allow extended testing of equipment under microgravity conditions. Separate designs have been formulated for air revitalization and water recovery test beds. In order to allow testing of a variety of hardware with minimal alteration of the beds themselves, the designs include storage tanks, plumbing, and limited instrumentation that would be expected to be common to all air (or water) treatment equipment of interest. In the interest of minimizing spacecraft/test bed interface requirements, the beds are designed to recycle process fluids to the greatest extent possible. In most cases, only cooling water and power interfaces are required. A volume equal to that of two SSF lockers was allowed for each design. These bed dimensions would limit testing to equipment with a 0.5- to 1.5-person-equivalent throughput. The mass, volume, and power requirements for the air revitalization test bed are estimated at 125-280 kg, 1.0- 1.4 cubic meters, and 170 min 1070 W. Corresponding ranges for the water recovery test bed are 325-375 kg, 1.0-1.1 cubic meters, and 350-850 W. These figures include individual test articles and accompanying hardware as well as the tanks, plumbing, and instrumentation included in the bed designs. Process fluid weight (i.e., water weight) is also included. Author

N93-22641*# McDonnell-Douglas Corp., Saint Louis, MO. Space Station Div.

WP-2 ATTACHED PAYLOAD ACCOMMODATIONS

Jim Scheib *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 415-424 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

The presentation provides an overview of the current SSFP attached payload accommodations on the U.S. truss. The overview includes discussions on the four attach sites, the power architecture, thermal control, DMS provisions, and the mechanical attach mechanism. The presentation concludes with a description of a McDonnell Douglas concept for an attached payload pallet designed to take advantage of the four sites and existing SSF hardware. This presentation should provide the payload community with a basic understanding of the SSF attached payload utility ports and aid in attached payload concept development. Author

N93-22642*# National Aeronautics and Space Administration, Washington, DC.

RESEARCH OBJECTIVES, OPPORTUNITIES, AND FACILITIES FOR MICROGRAVITY SCIENCE c29

Robert J. Bayuzick *In its* Space Station Freedom Utilization Conference 1992 p 427-462 Prepared in cooperation with Vanderbilt Univ., Nashville, TN (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

Microgravity Science in the U.S.A. involves research in fluids science, combustion science, materials science, biotechnology, and fundamental physics. The purpose is to achieve a thorough understanding of the effects of gravitational body forces on physical phenomena relevant to those disciplines. This includes the study of phenomena which are usually overwhelmed by the presence of gravitational body forces and, therefore, chiefly manifested when gravitational forces are weak. In the pragmatic sense, the research involves gravity level as an experimental parameter. Calendar year 1992 is a landmark year for research opportunities in low earth orbit for Microgravity Science. For the first time ever, three Spacelab flights will fly in a single year: IML-1 was launched on January 22; USML-1 was launched on June 25; and, in September, SL-J will be launched. A separate flight involving two cargo bay carriers, USMP-1, will be launched in October. From the beginning of 1993 up to and including the Space Station era (1997), nine flights involving either Spacelab or USMP carriers will be flown. This will be augmented by a number of middeck payloads and get away specials flying on various flights. All of this activity sets the stage for experimentation on Space Station Freedom. Beginning in 1997, experiments in Microgravity Science will be conducted on the Space Station. Facilities for doing experiments in protein crystal growth, solidification, and biotechnology will all be available. These will be joined by middeck-class payloads and the microgravity glove box for conducting additional experiments. In 1998, a new generation protein crystal growth facility and a facility for conducting combustion research will arrive. A fluids science facility and additional capability for conducting research in solidification, as well as an ability to handle small payloads on a quick response basis, will be added in 1999. The year 2000 will see upgrades in the protein crystal growth and fluids science facilities. From the beginning of 1997 to the fall of 1999 (the 'man-tended capability' era), there will be two or three utilization flights per year. Plans call for operations in Microgravity Science during utilization flights and between utilization flights. Experiments conducted during utilization flights will characteristically require crew interaction, short duration, and less sensitivity to perturbations in the acceleration environment. Operations between utilization flights will involve experiments that can be controlled remotely and/or can be automated. Typically, the experiments will require long times and a pristine environment. Beyond the fall of 1999 (the 'permanently-manned capability' era), some payloads will require crew interaction; others will be automated and will make use of telescience.
Author

N93-22643*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

SPACE STATION FREEDOM COMBUSTION RESEARCH c29

G. M. Faeth *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 463-474 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

Extended operations in microgravity, on board spacecraft like Space Station Freedom, provide both unusual opportunities and unusual challenges for combustion science. On the one hand, eliminating the intrusion of buoyancy provides a valuable new perspective for fundamental studies of combustion phenomena. On the other hand, however, the absence of buoyancy creates new hazards of fires and explosions that must be understood to assure safe manned space activities. These considerations - and the relevance of combustion science to problems of pollutants, energy utilization, waste incineration, power and propulsion systems, and fire and explosion hazards, among others - provide strong motivation for microgravity combustion research. The intrusion of buoyancy is a greater impediment to fundamental combustion studies than to most other areas of science. Combustion intrinsically heats gases with the resulting buoyant motion at normal gravity either preventing or vastly complicating measurements. Perversely, this limitation is most evident for fundamental laboratory experiments; few practical combustion phenomena are significantly affected by buoyancy. Thus, we have never observed the most fundamental combustion phenomena - laminar premixed and diffusion flames, heterogeneous flames of particles and surfaces, low-speed turbulent flames, etc. - without substantial buoyant disturbances. This precludes rational merging of theory, where buoyancy is of little interest, and experiments, that always are contaminated by buoyancy, which is the traditional path for developing most areas of science. The current microgravity combustion program seeks to rectify this deficiency using both ground-based and space-based facilities, with experiments involving space-based facilities including: laminar premixed flames, soot processes in laminar jet diffusion flames, structure of laminar and turbulent jet diffusion flames, solid surface combustion, one-dimensional smoldering, ignition and flame spread of liquids, drop combustion, and quenching of panicle-air flames. Unfortunately, the same features that make microgravity attractive for fundamental combustion experiments, introduce new fire and explosion hazards that have no counterpart on earth. For example, microgravity can cause broader flammability limits, novel regimes of flame spread, enhanced effects of flame radiation, slower fire detector response, and enhanced combustion upon injecting fire extinguishing agents, among others. On the other hand, spacecraft provide an opportunity to use 'fire-safe' atmospheres due to their controlled environment. Investigation of these problems is just beginning, with specific fire safety experiments supplementing the space based fundamental experiments listed earlier; thus, much remains to be done to develop an adequate technology base for fire and explosion safety considerations for spacecraft. Author (revised)

N93-22644*# National Aeronautics and Space Administration, Washington, DC.

MICROGRAVITY FLUID PHYSICS RESEARCH IN THE SPACE STATION FREEDOM ERA **c29**

Bradley M. Carpenter *In its* Space Station Freedom Utilization Conference 1992 p 475-479 (For primary document see N93-22606 08-18)

Avail: CASI HC A01/MF A04

Microgravity fluid physics covers an exciting range of established and potential fields of scientific research. Areas in which the Microgravity Science and Applications Division of NASA's Office of Space Science and Applications is currently supporting research include: multiphase flow and phase change heat transfer, behavior of granular media and colloids; and interface dynamics, morphological stability, and contact line phenomena. As they contribute to our knowledge of fluid behavior, advances in these areas will enhance our understanding of materials processing on Earth and in space, and will contribute to technologies as diverse as chemical extraction, the prediction of soil behavior in earthquakes, and the production of oil reservoirs. NASA' s primary platform for research in microgravity fluid physics will soon be the Fluid Physics/Dynamics Facility on Space Station Freedom. This facility shares a rack for control and utilities with the Modular Combustion Facility, and has one rack for experiment-unique instruments. It is planned to change out the content of the experiment-unique rack at intervals on the order of one year. In order to obtain a maximum return on the operation of the facility during these intervals, the research community must carefully plan and coordinate an effort that brings the efforts of many investigators to bear on problems of particular importance. NASA is currently working with the community to identify research areas in which microgravity can make a unique and valuable contribution, and to build a balanced program of research around these areas or thrusts. Selections will soon be made from our first solicitation for research in fluid dynamics and transport phenomena. These solicitations will build the research community that will make Space Station Freedom a catalyst for scientific and technological discovery, and offer U.S. scientists in many disciplines a unique opportunity to participate in space science.

Author (revised)

N93-22645*# Wisconsin Univ., Madison. Dept. of Materials Science and Engineering.

MATERIALS SCIENCE RESEARCH IN MICROGRAVITY **c29**

John H. Perepezko *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 481-500 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

There are several important attributes of an extended duration microgravity environment that offer a new dimension in the control of the microstructure, processing, and properties of materials. First, when gravitational effects are minimized, buoyancy driven convection flows are also minimized. The flows due to density differences, brought about either by composition or temperature gradients will then be reduced or eliminated to permit a more precise control of the temperature and the composition of a melt which is critical in achieving high quality crystal growth of electronic materials or alloy structures. Secondly, body force effects such as sedimentation, hydrostatic pressure, and deformation are similarly reduced. These effects may interfere with attempts to produce uniformly dispersed or aligned second phases during melt solidification. Thirdly, operating in a microgravity environment will facilitate the containerless processing of melts to eliminate the limitations of containment for reactive melts. The noncontacting forces such as those developed from electromagnet, electrostatic, or acoustic fields can be used to position samples. With this mode of operation, contamination can be minimized to enable the study of reactive melts and to eliminate extraneous crystal nucleation so that novel crystalline structures and new glass compositions may be produced. In order to take advantage of the microgravity environment for materials research, it has become clear that reliable processing models based on a sound ground based experimental experience and an established thermophysical property data base are essential. Author (revised)

N93-22646*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PROTEIN CRYSTAL GROWTH IN MICROGRAVITY **c29**

Daniel Carter *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 501-509 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

The overall scientific goals and rationale for growing protein crystals in microgravity are discussed. Data on the growth of human serum albumin crystals which were produced during the First International Microgravity Laboratory (IML-1) are presented. Potential scientific advantages of the utilization of Space Station Freedom are discussed. Author (revised)

N93-22647*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

OFFICE OF COMMERCIAL PROGRAMS' RESEARCH ACTIVITIES FOR SPACE STATION FREEDOM UTILIZATION

James A. Fountain *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 511-530 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

One of the objectives of the Office of Commercial Programs (OCP) is to encourage, enable, and help implement space research which meets the needs of the U.S. industrial sector. This is done mainly through seventeen Centers for the Commercial Development of Space (CCDS's) which are located throughout the United States. The CCDS's are composed of members from U.S. companies, universities, and other government agencies. These Centers are presently engaged in industrial research in space using a variety of carriers to reach low Earth orbit. One of the goals is to produce a body of experience and knowledge that will allow U.S. industrial entities to make informed decisions regarding their participation in commercial space endeavors. A total of 32 items of payload hardware were built to date. These payloads have flown in space a total of 73 times. The carriers range from the KC-135 parabolic aircraft and expendable launch vehicles to the Space Shuttle. This range of carriers allows the experimenter to evolve payloads in complexity and cost by progressively extending the time in microgravity. They can start with a few seconds in the parabolic aircraft and go to several minutes on the rocket flights, before they progress to the complexities of manned flight on the Shuttle. Next year, two new capabilities will become available: COMET, an expendable-vehicle-launched experiment capsule that can carry experiments aloft for thirty days; and SPACEHAB, a new Shuttle borne module which will greatly add to the capability to accommodate small payloads. All of these commercial research activities and carrier capabilities are preparing the OCP to evolve those experiments that prove successful to Space Station Freedom. OCP and the CCDS's are actively involved in Space Station design and utilization planning and have proposed a set of experiments to be launched in 1996 and 1997. These experiments are to be conducted both internal and external to Space Station Freedom and will investigate industrial research topics which range from biotechnology to electronic materials to metallurgy. Some will be designed to make maximum use of the quiescent microgravity conditions in the 'ground-tended' phases during the early years of Space Station Freedom operations. Author (revised)

N93-22648*# Alabama Univ., Birmingham. Center for Macromolecular Crystallography.

LARGE SCALE CRYSTALLIZATION OF PROTEIN PHARMACEUTICALS IN MICROGRAVITY VIA TEMPERATURE CHANGE **c29**

Marianna M. Long *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 531-552 (For primary document see N93-22606 08-18)

(Grant NAGw-813)

Avail: CASI HC A03/MF A04

The major objective of this research effort is the temperature driven growth of protein crystals in large batches in the microgravity environment of space. Pharmaceutical houses are developing protein products for patient care, for example, human insulin, human growth hormone, interferons, and tissue plasminogen activator or TPA, the clot buster for heart attack victims. Except for insulin, these are very high value products; they are extremely potent in small quantities and have a great value per gram of material. It is feasible that microgravity crystallization can be a cost recoverable, economically sound final processing step in their manufacture. Large scale protein crystal growth in microgravity has significant advantages from the basic science and the applied science standpoints. Crystal growth can proceed unhindered due to lack of surface effects. Dynamic control is possible and relatively easy. The method has the potential to yield large

quantities of pure crystalline product. Crystallization is a time honored procedure for purifying organic materials and microgravity crystallization could be the final step to remove trace impurities from high value protein pharmaceuticals. In addition, microgravity grown crystals could be the final formulation for those medicines that need to be administered in a timed release fashion. Long lasting insulin, insulin lente, is such a product. Also crystalline protein pharmaceuticals are more stable for long-term storage. Temperature, as the initiation step, has certain advantages. Again, dynamic control of the crystallization process is possible and easy. A temperature step is non-invasive and is the most subtle way to control protein solubility and therefore crystallization. Seeding is not necessary. Changes in protein and precipitant concentrations and pH are not necessary. Finally, this method represents a new way to crystallize proteins in space that takes advantage of the unique microgravity environment. The results from two flights showed that the hardware performed perfectly, many crystals were produced, and they were much larger than their ground grown controls. Morphometric analysis was done on over 4,000 crystals to establish crystal size, size distribution, and relative size. Space grown crystals were remarkably larger than their earth grown counterparts and crystal size was a function of PCF volume. That size distribution for the space grown crystals was a function of PCF volume may indicate that ultimate size was a function of temperature gradient. Since the insulin protein concentration was very low, 0.4 mg/ml, the size distribution could also be following the total amount of protein in each of the PCF's. X-ray analysis showed that the bigger space grown insulin crystals diffracted to higher resolution than their ground grown controls. When the data were normalized for size, they still indicated that the space crystals were better than the ground crystals. Author (revised)

N93-22649*# Pennsylvania State Univ., University Park. Center for Cell Research.

COMMERCIAL OPPORTUNITIES IN BIOSEPARATIONS AND PHYSIOLOGICAL TESTING ABOARD SPACE STATION FREEDOM c51

W. C. Hymer *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 553-566 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

The Center for Cell Research (CCR) is a NASA Center for the Commercial Development of Space which has as its main goal encouraging industry-driven biomedical/biotechnology space projects. Space Station Freedom (SSF) will provide long duration, crew-tended microgravity environments which will enhance the opportunities for commercial biomedical/biotechnology projects in bioseparations and physiological testing. The CCR bioseparations program, known as USCEPS (for United States Commercial Electrophoresis Program in Space), is developing access for American industry to continuous-flow electrophoresis aboard SSF. In space, considerable scale-up of continuous free-flow electrophoresis is possible for cells, sub cellular particles, proteins, growth factors, and other biological products. The lack of sedemination and buoyancy-driven convection flow enhances purity of separations and the amount of material processed/time. Through the CCR's physiological testing program, commercial organizations will have access aboard SSF to physiological systems experiments (PSE's); the Penn State Biomodule; and telemicroscopy. Physiological systems experiments involve the use of live animals for pharmaceutical product testing and discovery research. The Penn State Biomodule is a computer-controlled mini lab useful for projects involving live cells or tissues and macro molecular assembly studies, including protein crystallization. Telemicroscopy will enable staff on Earth to manipulate and monitor microscopic specimens on SSF for product development and discovery research or for medical diagnosis of astronaut health problems. Space-based product processing, testing, development, and discovery research using USCEPS and CCR's physiological testing program offer new routes to improved health on Earth. Direct crew involvement-in biomedical/biotechnology projects aboard SSF will enable better experimental outcomes. The current data base shows that there is reason for considerable optimism regarding what the CCDS program and the biomedical/biotechnology industry can expect to gain from a permanent manned presence in space. Author (revised)

N93-22650*# Alabama Univ., Huntsville. Consortium for Materials Development in Space.

CONSORTIUM FOR MATERIALS DEVELOPMENT IN SPACE INTERACTION WITH SPACE STATION FREEDOM c24

Charles A. Lundquist and Valerie Seaquist *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 567-573 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

The Consortium for Materials Development in Space (CMDS) is one of seventeen Centers for the Commercial Development of Space (CCDS) sponsored by the Office of Commercial Programs of NASA. The CMDS formed at the University of Alabama in Huntsville in the fall of 1985. The Consortium activities therefore will have progressed for over a decade by the time Space Station Freedom (SSF) begins operation. The topic to be addressed here is: what are the natural, mutually productive relationships between the CMDS and SSF? For management and planning purposes, the Consortium organizes its activities into a number of individual projects. Normally, each project has a team of personnel from industry, university, and often government organizations. This is true for both product-oriented materials projects and for infrastructure projects. For various projects Space Station offers specific mutually productive relationships. First, SSF can provide a site for commercial operations that have evolved as a natural stage in the life cycle of individual projects. Efficiency and associated cost control lead to another important option. With SSF in place, there is the possibility to leave major parts of processing equipment in SSF, and only bring materials to SSF to be processed and return to earth the treated materials. This saves the transportation costs of repeatedly carrying heavy equipment to orbit and back to the ground. Another generic feature of commercial viability can be the general need to accomplish large through-put or large scale operations. The size of SSF lends itself to such needs. Also in addition to processing equipment, some of the other infrastructure capabilities developed in CCDS projects may be applied on SSF to support product activities. The larger SSF program may derive mutual benefits from these infrastructure abilities. Author

N93-22651*# Alabama Univ., Huntsville. Consortium for Materials Development in Space.

MATERIALS DISPERSION AND BIODYNAMICS PROJECT RESEARCH c51

Marian L. Lewis *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 575-588 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

The Materials Dispersion and Biodynamics Project (MDBP) focuses on dispersion and mixing of various biological materials and the dynamics of cell-to-cell communication and intracellular molecular trafficking in microgravity. Research activities encompass biomedical applications, basic cell biology, biotechnology (products from cells), protein crystal development, ecological life support systems (involving algae and bacteria), drug delivery (microencapsulation), biofilm deposition by living organisms, and hardware development to support living cells on Space Station Freedom (SSF). Project goals are to expand the existing microgravity science database through experiments on sounding rockets, the Shuttle, and COMET program orbiters and to evolve,through current database acquisition and feasibility testing, to more mature and larger-scale commercial operations on SSF. Maximized utilization of SSF for these science applications will mean that service companies will have a role in providing equipment for use by a number of different customers. An example of a potential forerunner of such a service for SSF is the Materials Dispersion Apparatus (MDA) 'mini lab' of Instrumentation Technology Associates, Inc. (ITA) in use on the Shuttle for the Commercial MDAITA Experiments (CMIX) Project. The MDA wells provide the capability for a number of investigators to perform mixing and bioprocessing experiments in space. In the area of human adaptation to microgravity, a significant database has been obtained over the past three decades. Some low-g effects are similar to Earth-based disorders (anemia, osteoporosis, neuromuscular diseases, and immune system disorders). As new information targets potential profit-making processes, services and products from microgravity, commercial space ventures are expected to expand accordingly. Cooperative CCDS research in the above mentioned areas is essential for maturing SSF biotechnology and to ensure U.S. leadership in space technology. Currently, the MDBP conducts collaborative research with investigators at the Rockefeller University, National Cancer Institute, and the Universities of California, Arizona, and Alabama in Birmingham. The growing database from these collaborations provides fundamental information applicable to development of cell products,

manipulation of immune cell response, bone cell growth and mineralization, and other processes altered by low-gravity. Contacts with biotechnology and biopharmaceutical companies are being increased to reach uninformed potential SSF users, provide access through the CMDS to interested users for feasibility studies, and to continue active involvement of current participants. We encourage and actively seek participation of private sector companies, and university and government researchers interested in biopharmaceuticals, hardware development and fundamental research in microgravity. Author (revised)

N93-22652*# Boeing Defense and Space Group, Seattle, WA.
INTEGRATION AND USE OF MICROGRAVITY RESEARCH FACILITY: LESSONS LEARNED BY THE CRYSTALS BY VAPOR TRANSPORT EXPERIMENT AND SPACE EXPERIMENTS FACILITY PROGRAMS c29
Barbara L. Heizer *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 589-600 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

The Crystals by Vapor Transport Experiment (CVTE) and Space Experiments Facility (SEF) are materials processing facilities designed and built for use on the Space Shuttle mid deck. The CVTE was built as a commercial facility owned by the Boeing Company. The SEF was built under contract to the UAH Center for Commercial Development of Space (CCDS). Both facilities include up to three furnaces capable of reaching 850 C minimum, stand-alone electronics and software, and independent cooling control. In addition, the CVTE includes a dedicated stowage locker for cameras, a laptop computer, and other ancillary equipment. Both systems are designed to fly in a Middeck Accommodations Rack (MAR), though the SEF is currently being integrated into a Spacehab rack. The CVTE hardware includes two transparent furnaces capable of achieving temperatures in the 850 to 870 C range. The transparent feature allows scientists/astronauts to directly observe and affect crystal growth both on the ground and in space. Cameras mounted to the rack provide photodocumentation of the crystal growth. The basic design of the furnace allows for modification to accommodate techniques other than vapor crystal growth. Early in the CVTE program, the decision was made to assign a principal scientist to develop the experiment plan, affect the hardware/software design, run the ground and flight research effort, and interface with the scientific community. The principal scientist is responsible to the program manager and is a critical member of the engineering development team. As a result of this decision, the hardware/experiment requirements were established in such a way as to balance the engineering and science demands on the equipment. Program schedules for hardware development, experiment definition and material selection, flight operations development and crew training, both ground support and astronauts, were all planned and carried out with the understanding that the success of the program science was as important as the hardware functionality. How the CVTE payload was designed and what it is capable of, the philosophy of including the scientists in design and operations decisions, and the lessons learned during the integration process are descussed. Author (revised)

N93-22777# California Univ., Berkeley. Lawrence Berkeley Lab.
A COMPARISON OF THE SPACE STATION VERSION OF ASTROMAG WITH TWO FREE-FLYER VERSIONS
M. A. Green Jun. 1992 15 p Presented at the 1992 Space Cryogenics Workshop, Otobrum, Germany, 15-16 Jun. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004695; LBL-32977; CONF-9206328-1) Avail: CASI HC A03/MF A01

The Space Station version of ASTROMAG is compared with free-flyer versions of ASTROMAG which could fly on an Atlas 2a rocket and a Delta rocket. Launch with either free-flyer imposes severe weight limits on the magnet and its cryogenic system. Both versions of ASTROMAG magnet which fly on free-flying satellites do not have to be charged more than once during the mission. This permits one to simplify the charging system and the cryogenic system. The helium 2 pump loop which supplies helium to the gas cooled electrical leads can be eliminated in both of the free-flyer versions of the ASTROMAG magnet. The superconducting dipole moment correction coils which are necessary for the magnet to operate on a free-flying satellite are described. DOE

N93-22906# Los Alamos National Lab., NM.
DUAL USE OF DISTRIBUTED REMOTE SENSING SATELLITES
G. H. Canavan 2 Dec. 1992 7 p Presented at the Global Ecological Monitoring Project, Dubna, Russia, 8-12 Aug. 1992
(Contract W-7405-eng-36)
(DE93-005442; LA-UR-92-4110; CONF-9208198-1) Avail: CASI HC A02/MF A01

Satellites can serve both defense and the environment, simultaneously monitoring preparations for aggression, the environment, pollution, and natural disasters. These applications have been discussed extensively in international meetings, which have produced specific projects for cooperation and growing acceptance of dual-use concepts. DOE

N93-23001*# National Aeronautics and Space Administration, Washington, DC.
SPACE STATION FREEDOM UTILIZATION CONFERENCE. EXECUTIVE SUMMARY
Mar. 1993 34 p Conference held in Huntsville, AL, 3-6 Aug. 1992
(NASA-TM-108709; NAS 1.15:108709) Avail: CASI HC A03/MF A01

The Space Station Freedom Utilization Conference was held on 3-6 Aug. 1992 in Huntsville, Alabama. The purpose of the conference was to bring together prospective space station researchers and the people in NASA and industry with whom they would be working to exchange information and discuss plans and opportunities for space station research. Topics covered include: research capabilities; research plans and opportunities; life sciences research; technology research; and microgravity research and biotechnology. CASI

N93-23009*# Eril Research, Inc., San Rafael, CA.
P0004-1 QUICK LOOK Final Report
16 Oct. 1991 28 p
(Contract NAS8-38676)
(NASA-CR-192459; NAS 1.26:192459) Avail: CASI HC A03/MF A01

The P0004-1 'Seeds in Space' experiment consisted of six sealed aluminum canisters which contained tomato seeds and a variety of other seeds for the study of space radiation effects on the seeds. The seeds were contained in cloth bags. Interspersed among the bags of seeds were ten dosimeter packets to monitor the accumulated ionizing radiation exposure of the seeds. In addition to the ten flight dosimeter packets, four ground control packets and one ground movement packet were also included as part of the experiment. The P0004-1 experiment was mounted on the F2 tray, near the trailing edge of the LDEF orbiter. The results indicate that the neutron fluences were higher in the P0004 canisters than in that of P0006. The difference was much greater for thermal neutrons than resonance neutrons. This is consistent with shielding. Author

N93-23040*# National Aeronautics and Space Administration, Washington, DC.
GROUP TASK FORCE ON SATELLITE RESCUE AND REPAIR Technical Report
29 Sep. 1992 40 p
(NASA-TM-108713; NAS 1.15:108713) Avail: CASI HC A03/MF A01

The Group Task Force was chartered by the Administrator of NASA to recommend 'a policy outlining the criteria, the design standards, and the pricing model to guide NASA in assessing the responsibilities for government and nongovernment Satellite Rescue and Repair Missions.' Criteria for accepting such missions, risks, and benefits to all sectors of our economy involved in satellite services, adequacy of planning and training, and the impact on NASA's primary mission were reviewed. The Group began by asking a more fundamental question; is satellite rescue and repair a logical element of NASA's mission? Factors considered were: (1) the probability of rescue or repair opportunities arising; (2) the economic justification for such attempts; (3) the benefits to NASA, both from such ad hoc learning experiences in space operations and the impact on the public perception of NASA; (4) the effect of such unanticipated missions on NASA's scheduled activities; (5) any potential effect on NASA's technical capability to work in space; and (6) any potential effect on U.S. economic competitiveness. Author (revised)

N93-23131*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.

IONOSPHERIC PLASMA FLOW ABOUT A SYSTEM OF ELECTRICALLY BIASED FLAT PLATES M.S. Thesis - Cleveland State Univ. Final Report

Joel L. Herr Apr. 1993 95 p

(Contract NAS3-25266; RTOP 506-41-52)

(NASA-CR-191119; E-7732; NAS 1.26:191119) Avail: CASI HC A05/MF A01

The steady state interaction of two electrically biased parallel plates immersed in a flowing plasma characteristic of low earth orbit is studied numerically. Fluid equations are developed to describe the motion of the cold positively charged plasma ions, and are solved using finite-differences in two dimensions on a Cartesian grid. The behavior of the plasma electrons is assumed to be described by the Maxwell-Boltzmann distribution. Results are compared to an analytical and a particle simulation technique for a simplified flow geometry consisting of a single semi-infinite negatively biased plate. Comparison of the extent of the electrical disturbance into the flowing plasma and the magnitude of the current collected by the plate is very good. The interaction of two equally biased parallel plates is studied as a function of applied potential. The separation distance at which the current collected by either plate decreases by five and twenty percent is determined as a function of applied potential. The percent decreases were based on a non-interacting case. The decrease in overall current is caused by a decrease in ionic density in the region between the plates. As the separation between the plates decreases, the plates collect the ions at a faster rate than they are supplied to the middle region by the oncoming plasma flow. The docking of spacecraft in orbit is simulated by moving two plates of unequal potential toward one another in a quasi-static manner. One plate is held at a large negative potential while the other floats electrically in the resulting potential field. It is found that the floating plate does not charge continuously negative as it approaches the other more negatively biased plate. Instead, it charges more and then less negative as ionic current decreases and then increases respectively upon approach. When the two plates come into contact, it is expected that the electrically floating plate will charge rapidly negative to a potential near that of the other plate. Author

N93-23139*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ORBITER AUTOLAND RELIABILITY ANALYSIS

D. Phillip Welch Apr. 1993 390 p

(NASA-TM-4464; S-712; NAS 1.15:4464) Avail: CASI HC A17/MF A04

The Space Shuttle Orbiter is the only space reentry vehicle in which the crew is seated upright. This position presents some physiological effects requiring countermeasures to prevent a crewmember from becoming incapacitated. This also introduces a potential need for automated vehicle landing capability. Autoland is a primary procedure that was identified as a requirement for landing following and extended duration orbiter mission. This report documents the results of the reliability analysis performed on the hardware required for an automated landing. A reliability block diagram was used to evaluate system reliability. The analysis considers the manual and automated landing modes currently available on the Orbiter. (Autoland is presently a backup system only.) Results of this study indicate a +/- 36 percent probability of successfully extending a nominal mission to 30 days. Enough variations were evaluated to verify that the reliability could be altered with missions planning and procedures. If the crew is modeled as being fully capable after 30 days, the probability of a successful manual landing is comparable to that of Autoland because much of the hardware is used for both manual and automated landing modes. The analysis indicates that the reliability for the manual mode is limited by the hardware and depends greatly on crew capability. Crew capability for a successful landing after 30 days has not been determined yet. Author (revised)

N93-23168*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

GEOTAIL SPACECRAFT HISTORICAL DATA REPORT

George R. Boersig and Lawrence F. Kruse Mar. 1993 36 p

(NASA-TM-108710; NAS 1.15:108710; K-CM-HDR-D-212) Avail: CASI HC A03/MF A01

The purpose of this GEOTAIL Historical Report is to document ground processing operations information gathered on the GEOTAIL mission during processing activities at the Cape Canaveral Air Force Station (CCAFS). It is hoped that this report may aid management analysis, improve integration processing and forecasting of processing trends, and reduce real-time schedule changes. The GEOTAIL payload is the third Delta 2 Expendable Launch Vehicle (ELV) mission to document historical data. Comparisons of planned versus as-run schedule information are displayed. Information will generally fall into the following categories: (1) payload stay times (payload processing facility/hazardous processing facility/launch complex-17A); (2) payload processing times (planned, actual); (3) schedule delays; (4) integrated test times (experiments/launch vehicle); (5) unique customer support requirements; (6) modifications performed at facilities; (7) other appropriate information (Appendices A & B); and (8) lessons learned (reference Appendix C). Derived from text

N93-23247*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

IMPACT EXPERIMENTS INTO MULTIPLE-MESH TARGETS: CONCEPT DEVELOPMENT OF A LIGHTWEIGHT COLLISIONAL BUMPER

Friedrich Hoerz, Mark J. Cintala, Ronald P. Bernhard (Lockheed Engineering and Sciences Co., Houston, TX.), Frank Cardenas (Lockheed Engineering and Sciences Co., Houston, TX.), William Davidson (Lockheed Engineering and Sciences Co., Houston, TX.), Gerald Haynes (Lockheed Engineering and Sciences Co., Houston, TX.), Thomas H. See (Lockheed Engineering and Sciences Co., Houston, TX.), Jerry Winkler (Lockheed Engineering and Sciences Co., Houston, TX.), and Barry Gray (Clear Lake High School, Houston, TX.) Mar. 1993 128 p Original contains color illustrations

(NASA-TM-104764; S-714; NAS 1.15:104764) Avail: CASI HC A07/MF A02; 54 functional color pages

The utility of multiple-mesh targets as potential lightweight shields to protect spacecraft in low-Earth orbit against collisional damage is explored. Earlier studies revealed that single meshes comminute hypervelocity impactors with efficiencies comparable to contiguous targets. Multiple interaction of projectile fragments with any number of meshes should lead to increased comminution, deceleration, and dispersion of the projectile, such that all debris exiting the mesh stack possesses low specific energies (ergs/sq cm) that would readily be tolerated by many flight systems. The study is conceptually exploring the sensitivity of major variables such as impact velocity, the specific areal mass (g/sq cm) of the total mesh stack (SM), and the separation distance (S) between individual meshes. Most experiments employed five or ten meshes with total SM typically less than 0.5 the specific mass of the impactor, and silicate glass impactors rather than metal projectiles. While projectile comminution increases with increasing impact velocity due to progressively higher shock stresses, encounters with multiple-meshes at low velocity (1-2 km/s) already lead to significant disruption of the glass impactors, with the resulting fragments being additionally decelerated and dispersed by subsequent meshes, and, unlike most contiguous single-plate bumpers, leading to respectable performance at low velocity. Total specific bumper mass must be the subject of careful trade-off studies; relatively massive bumpers will generate too much debris being dislodged from the bumper itself, while exceptionally lightweight designs will not cause sufficient comminution, deceleration, or dispersion of the impactor. Separation distance was found to be a crucial design parameter, as it controls the dispersion of the fragment cloud. Substantial mass savings could result if maximum separation distances were employed. The total mass of debris dislodged by multiple-mesh stacks is modestly smaller than that of single, contiguous-membrane shields. The cumulative surface area of all penetration holes in multiple mesh stacks is an order of magnitude smaller than that in analog multiple-foil shields, suggesting good long-term performance of the mesh designs. Due to different experimental conditions, direct and quantitative comparison with other lightweight shields is not possible at present. Author (revised)

N93-23415# Construcciones Aeronauticas S.A., Madrid (Spain).

COLUMBUS PROGRAM: GROUND STAFF TRAINING SIMULATION [PROGRAMA COLUMBUS: SIMULACION EN EL ENTRENAMIENTO DEL PERSONAL DE TIERRA]

Lia Noemi Tusanotte 1991 5 p Repr. from Revista de Aeronautica y Astronautica, Jul. - Aug. 1991 p 704-708 In SPANISH

(ETN-93-93694) Avail: CASI HC A01/MF A01

A report on training simulation for ground staff of the MSCC (Manned Space Laboratory Control Center) for the Columbus program is presented. CFFM (Columbus Free Flying Laboratory) operational and maintenance

factors are outlined and CFFL payload operation coordination is discussed. Routine operations scenarios are described. The methodology behind the training is discussed. ESA

N93-23506 Texas A&M Univ., College Station.
NONLINEAR ATTITUDE CONTROL OF SPACECRAFT AND MOMENTUM MANAGEMENT OF CONTROL MOMENT GYROS Ph.D. Thesis
Hwa-Suk Oh 1992 115 p
Avail: Univ. Microfilms Order No. DA9300490

Nonlinear design procedures are presented for obtaining attitude control and momentum management laws. These are based on the Liapunov stability theorems. The Work-Energy Rate (WER) principle is extended to cover general classes of systems. It is shown that the use of the WER principle for obtaining control laws, can reduce the design efforts. The attitude control laws are designed for several types of missions, i.e., absolute attitude and relative attitude control. The momentum management as well as attitude control laws are designed for both stable and unstable spacecraft configurations which use Control Moment Gyros (CMGs) as active actuators. A large stability region is found around the local-vertical-local-horizontal (LVLH) equilibrium point, and so the designed control laws can be used even in the event of large initial attitude deviations for LVLH. In the presence of constant disturbance, the momentum is managed by seeking a Torque Equilibrium Attitude (TEA) where the disturbance torque is balanced by gravity gradient and gyroscopic torques. This is done by the use of integral feedback of the control torque, which is related to the angular momentum of the CMGs. It is shown that the unknown constant disturbance can be identified by the use of integral feedback. Cyclic disturbance rejection for the pitch axis is performed by successive stabilization and integral feedback. Theoretical results developed are verified using both experimental and numerical simulations. Experimental model of a flexible spacecraft is used to demonstrate the applicability of the WER principle and the fact that under certain conditions, a control law based on a rigid body model, can be applied to a flexible spacecraft. Using a mathematical model of the Space Station Freedom, several attitude/momentum management control laws are simulated and shown to work successfully with/without a constant disturbance torque. The control law for cyclic disturbance rejection of pitch axis attitude is examined and found to work satisfactorily under the presence of cyclic disturbance. Dissert. Abstr.

N93-23742*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PLASMA CHAMBER TESTING OF APSA COUPONS FOR THE SAMPIE FLIGHT EXPERIMENT
G. Barry Hillard Jan. 1993 9 p Presented at the 31st Aerospace Sciences Meeting and Exhibit, Reno, NV, 11-14 Jan. 1993; sponsored by the AIAA Previously announced in IAA as A93-24244
(RTOP 589-01-1B)
(NASA-TM-106084; E-7707; NAS 1.15:106084; AIAA Paper 93-0568)
Avail: CASI HC A02/MF A01

Among the solar cell technologies to be tested in space as part of the Solar Array Module Plasma Interactions Experiment (SAMPIE) will be the Advanced Photovoltaic Solar Array (APSA). Several prototype twelve cell coupons were built for NASA using different blanket materials and mounting techniques. The first conforms to the baseline design for APSA which calls for the cells to be mounted on a carbon loaded Kapton blanket to control charging in GEO. When deployed, this design has a flexible blanket supported around the edges. A second coupon was built with the cells mounted on Kapton-H, which was in turn cemented to a solid aluminum substrate. A final coupon was identical to the latter but used germanium coated Kapton to control atomic oxygen attack in LEO. Ground testing of these coupons in a plasma chamber showed considerable differences in plasma current collection. The Kapton-H coupon demonstrated current collection consistent with exposed interconnects and some degree of cell snapover. The other two coupons experienced anomalously large collection currents. This behavior is believed to a consequence of enhanced plasma sheaths supported by the weakly conducting carbon and germanium used in these coupons. The results reported here are the first experimental evidence that the use of such materials can result in power losses to high voltage space power systems. Author

N93-23956 Texas A&M Univ., College Station.
MANEUVER AND VIBRATION CONTROL OF FLEXIBLE SPACE STRUCTURES BY LYAPUNOV STABILITY THEORY Ph.D. Thesis
Hyochoong Bang 1992 202 p
Avail: Univ. Microfilms Order No. DA9300392

This research is primarily aimed at developing control laws for maneuvers and vibration suppression of flexible space structures by using Lyapunov stability theory. The key point of the Lyapunov approach for flexible structure is to design stabilizing control laws by Lyapunov's second method without discretizing the partial differential equations modeling the original flexible systems into finite dimensional ordinary differential equations. The main analysis is focused on single axis slew maneuvers, for which both a constant gain feedback law and a near-minimum-time tracking control law are investigated. Also, results from ground-based experiments are reported which support the practical utility of the control laws. By optimization of the Lyapunov control laws, a strategy for selecting a best combination of feedback gains and shaping of the reference maneuver is suggested. The optimization is carried out with the admissible solutions constrained to satisfy the Lyapunov stability conditions. The objective is to find the stable solution which extremizes a prescribed closed loop performance optimality criterion. Optimization of the reference trajectory, in addition to feedback control gains, enables one to find an optimum reference motion which is parameterized through a shaping parameter which controls the sharpness of the switching in a near-band-band maneuver. As a performance objective for optimization, an index which measures the trade-off between residual energy and maneuver time is used. A generalization of the Lyapunov approach is introduced, which applies to hybrid coordinate discrete/distributed parameter systems. This generalization makes use of a novel hybrid version of Hamilton's canonical equations of the systems, which is an extension of the corresponding classical results for discrete coordinate systems. The rather general form of the resulting stable family of control laws is developed in terms of the Hamiltonian of a general class of nonlinear hybrid hybrid coordinate dynamical systems. As a further extension, nonlinear hybrid coordinate systems described by discrete quasi-coordinate systems such as three axis large angle maneuvers are included in designing stabilizing control laws. A different perspective on the Lyapunov approach is provided by introducing a work-energy rate principle for general hybrid coordinate systems. It turns out that, for multiple elastic domain systems, the boundary forces contribute to the control law design when a Lyapunov function is chosen to be a weighted combination of substructural kinetic and potential energy. The use of boundary forces is closely related to acceleration feedback, and this provides more design freedom for active vibration suppression for the associated control laws. Dissert. Abstr.

N93-24057# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
MINI-SATELLITE EXPLORATION OF VERY NEAR EARTH SPACE FUEL OBJECTS
19 Sep. 1992 8 p Presented at the 6th Annual American Inst. of Astronautics and Aeronautics/Utah State Univ. (AIAA/USU) Conference on Small Satellites, Logan, UT, 21-24 Sep. 1992
(Contract DE-AC07-76ID-01570)
(DE93-005253; EGG-M-92532; CONF-9209285-1) Avail: CASI HC A02/MF A01

A prospecting plan is presented to assay near Earth objects (NEO) for their potential to yield rocket fuel. The plan calls out small satellites as the near-term means to achieve low cost surveys and deep subsurface sampling of NEO composition. The water bearing classes of NEO to be considered are limited to those accessible in short time and with small thrusters. These include the water bearing clay objects (phylosilicates) at nearly trivial distances from Earth, and the recently identified water ice objects such as comet (#4015) 1979 VA. These objects are evaluated as small satellite prospecting and assay vehicle targets. DOE

N93-24149*# National Aeronautics and Space Administration, Washington, DC.
SPACE STATION FREEDOM AUTOMATION AND ROBOTICS: AN ASSESSMENT OF THE POTENTIAL FOR INCREASED PRODUCTIVITY
David J. Weeks, Wayne F. Zimmerman, Gregory E. Swietek, David H. Reid (Mitre Corp., Houston, TX.), Ronald B. Hoffman (Mitre Corp., Houston, TX.), Lambert W. Stammerjohn, Jr. (Mitre Corp., Houston, TX.), William Stoney (Mitre Corp., Houston, TX.), and Ali H. Ghovanlou (Mitre Corp.,

Houston, TX.) Mar. 1990 122 p Prepared in cooperation with Mitre Corp., Houston, TX
(NASA-TM-108714; NAS 1.15:108714) Avail: CASI HC A06/MF A02

This report presents the results of a study performed in support of the Space Station Freedom Advanced Development Program, under the sponsorship of the Space Station Engineering (Code MT), Office of Space Flight. The study consisted of the collection, compilation, and analysis of lessons learned, crew time requirements, and other factors influencing the application of advanced automation and robotics, with emphasis on potential improvements in productivity. The lessons learned data collected were based primarily on Skylab, Spacelab, and other Space Shuttle experiences, consisting principally of interviews with current and former crew members and other NASA personnel with relevant experience. The objectives of this report are to present a summary of this data and its analysis, and to present conclusions regarding promising areas for the application of advanced automation and robotics technology to the Space Station Freedom and the potential benefits in terms of increased productivity. In this study, primary emphasis was placed on advanced automation technology because of its fairly extensive utilization within private industry including the aerospace sector. In contrast, other than the Remote Manipulator System (RMS), there has been relatively limited experience with advanced robotics technology applicable to the Space Station. This report should be used as a guide and is not intended to be used as a substitute for official Astronaut Office crew positions on specific issues. Author

N93-24279# Phillips Lab., Hanscom AFB, MA.
ORBITING SPACE DEBRIS: DANGERS, MEASUREMENT AND MITIGATION Interim Report
Ross T. McNutt 1 Jun. 1992 238 p
(AD-A260533; AD-E201382; PL-TR-92-2146; ERP-1102) Avail: CASI HC A11/MF A03

Space debris is a growing environmental problem. Accumulation of objects in earth orbit threatens space systems through the possibility of collisions and runaway debris multiplication. The amount of debris in orbit is uncertain due to the lack of information on the population of debris between 1 and 10 centimeters diameter. Collisions with debris even smaller than 1 cm can be catastrophic due to the high orbital velocities involved. Research efforts are under way at NASA, United States Space Command and the Air Force Phillips Laboratory to detect and catalog the debris population in near-earth space. Current international and national laws are inadequate to control the proliferation of space debris. Space debris is a serious problem with large economic, military, technical and diplomatic components. Actions need to be taken now to: determine the full extent of the orbital debris problem; accurately predict the future evolution of the debris population; decide the extent of the debris mitigation procedures required; implement these policies on a global basis via an international treaty. Action must be initiated now, before the loss of critical space systems such as the space shuttle or the space station. GRA

N93-24298# *Spectral Sciences, Inc., Burlington, MA.*
THE THEORY BEHIND THE SOCRATES CODE Final Report, 9 May 1988 - 8 Jul. 1992
J. B. Elgin and L. S. Bernstein 6 Aug. 1992 88 p
(Contract F19628-88-C-0074)
(AD-A259987; AD-E201356; SSI-TR-216; PL-TR-92-2207) Avail: CASI HC A05/MF A01

The SOCRATES contamination model is described at length. The model allows for unsteady or steady simulation of contamination aboard a spacecraft via the direct simulation Monte Carlo method. The basis for the model is discussed, and sample calculations are given for an RCS engine firing at 320 kilometer altitude for three different orientations. These calculations are compared to visible data in the 6300 A region which is attributed to the forbidden transition between the O(1D) and O(3P) electronic states of atmospheric atomic oxygen. GRA

N93-24439# *Creare, Inc., Hanover, NH.*
DESIGN MANUAL FOR TWO-PHASE COMPONENTS OF SPACECRAFT THERMAL MANAGEMENT SYSTEMS Final Report, May 1990 - Aug. 1992
Christopher J. Crowley, Michael G. Izenson, James J. Barry, Jerry L. Martin, and Rebecca S. Ent Sep. 1992 317 p
(Contract F04611-90-C-0004)
(AD-A260027; AD-E201325; TM-1524; PL-TR-92-3002) Avail: CASI HC A14/MF A03

This design manual presents methods to design and model the performance of key two-phase components in thermal management systems for spacecraft. Components for both capillary- and mechanically-pumped loops are modeled including: forced-convection evaporators; droplet evaporators; two-phase transport lines, fittings, and tees; shear condensers; capillary condensers; and mechanical pumps. Heat pipe condensers are also included. The methods can be used for component design and sizing, analysis of component performance in system or component development tests, development and evaluation of analytical models for key phenomena, and integration with transient codes for system analysis. This manual describes in detail the analysis methods which have been used to produce software for component design. The software and methods are validated against experimental data whenever such data are available. When possible, simple design maps are presented for initial scoping calculations for sizing two-phase components. The basic analytical approach for these design methods is mechanistic, so that the mathematical models for component behavior are based upon the fundamental physics. Thus, the methods include inherent scaling with gravity, physical size, and fluid properties. This approach allows the models to be easily upgraded as new experimental data become available and includes the ability to assess the analytical uncertainty in design calculations. GRA

N93-24543*# Science Applications International Corp., Torrance, CA.
REUSABLE REENTRY SATELLITE SYSTEM SPECIFICATION. VOLUME 1-9 (Diskette Supplement)
8 Feb. 1990 191 p Diskette supplement: 2 IBM compatible 3.5-inch DSDD
(Contract NAS9-18202)
(NASA-CR-192969; NAS 1.26:192969; RRS-015;
NONP-Suppl-DK-93-159792) Avail: Issuing Activity (Center for Aerospace Information) HC/DK A14

The Reusable Reentry Satellite system is composed of the Payload Module (PM), the Reusable Reentry Vehicle (RRV), and the Launch and Mission Support (LMS) segments. The nine volumes that comprise this system specification establish the performance, design, development, and test requirements for the Reusable Reentry Satellite (RRS) system. Included in this system specification are two 3.5 in. diskettes that contain the following: RRS midterm specifications; and RRS figures and tables.
Derived from text

N93-22097*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ENTRY SYSTEMS PANEL
Daniel J. Rasky, Donald R. Rummler (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.), Charlie Bersch (Institute for Defense Analyses, Alexandria, VA.), and Sidney C. Dixon (Schafer, W. J. Associates, Inc., Arlington, VA.) *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 259-270 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

N93-22099*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
BUILT-UP Al-Li STRUCTURES FOR CRYOGENIC TANK AND DRY BAY APPLICATIONS
W. Barry Lisagor *In its* Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 279-287 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

N93-22105*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ENTRY SYSTEMS PANEL DELIBERATIONS
Daniel J. Rasky, Donald R. Rummler (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.), Charlie Bersch (Institute for Defense Analyses, Alexandria, VA.), and Sidney C. Dixon (Schafer, W. J. Associates, Inc., Arlington, VA.) *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology

Workshop. Volume 2: Proceedings Feb. 1993 p 329-333 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

N93-22108*# Rockwell International Corp., Downey, CA. Space Systems Div.
REENTRY SYSTEMS: MATERIAL TECHNOLOGY NEEDS
Richard Michael Ehret *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 359-362 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

N93-22109*# McDonnell-Douglas Space Systems Co., Huntington Beach, CA.
THERMAL PROTECTION SYSTEMS FOR ALL-WEATHER REUSABLE LAUNCH VEHICLES
Marc J. Giegerich *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 363-367 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

N93-22176*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LEARNING CHARACTERISTICS OF A SPACE-TIME NEURAL NETWORK AS A TETHER SKIPROPE OBSERVER
Robert N. Lea, James A. Villarreal, Yashvant Jani (Togai InfraLogic, Inc., Houston, TX.), and Charles Copeland (Loral Space Information Systems, Houston, TX.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 262-273 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

N93-22230*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
AN AUTOMATED SYSTEM FOR SPACECRAFT PROXIMITY OPERATIONS Abstract Only
E. Bergmann *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22233*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
***MANNED MANEUVERING UNIT APPLICATIONS FOR AUTOMATED RENDEZVOUS AND CAPTURE* Abstract Only**
Donald L. Brehm (Martin Marietta Corp., Denver, CO.), John A. Cuseo (Martin Marietta Corp., Denver, CO.), Joseph A. Lenda (Martin Marietta Corp., Denver, CO.), Lex Ray (Martin Marietta Corp., Denver, CO.), and C. Edward Whitsett *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22238*# Lockheed Engineering and Sciences Co., Houston, TX.
AUTONOMOUS PREALIGNMENT OF A DOCKING MECHANISM Abstract Only
Monty B. Carroll and John A. Thompson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22244*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTONOMOUS RENDEZVOUS AND CAPTURE SYSTEM DESIGN Abstract Only
Richard W. Dabney *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22246*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CONTROL OF A VARYING THRUST SPACECRAFT FOR AUTONOMOUS SPACE RENDEZVOUS Abstract Only
Travis E. Dawson, Jr. *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22248*# Rockwell International Corp., Anaheim, CA. Autonetics Strategic Systems Div.
RENDEZVOUS STRATEGY IMPACTS ON CTV AVIONICS DESIGN, SYSTEM RELIABILITY REQUIREMENTS, AND AVAILABLE COLLISION AVOIDANCE MANEUVERS Abstract Only
William J. Donovan and John E. Davis *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22254*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FLIGHT SUPPORT SYSTEM (FSS) DOCKING AND UMBILICAL SERVICES SYSTEMS Abstract Only
Edward Falkenhayn *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22255*# TRW, Inc., Redondo Beach, CA. Engineering and Test Div.
ON-BOARD FAULT MANAGEMENT FOR AUTONOMOUS SPACECRAFT Abstract Only
Lorraine M. Fesq, Amy Stephan, Susan C. Doyle, Eric Martin, and Suzanne Sellers *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22257*# Rockwell International Corp., Downey, CA. Space Systems Div.
AUTOMATED RENDEZVOUS AND PROXIMITY OPERATIONS Abstract Only
Anton F. Flecklin, II *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22259*# *Alabama Univ., Huntsville. Holography, Applied Mechanics, and Photonics Lab.*
A PARC SYSTEM FOR TERMINAL DOCKING Abstract Only
John A. Gilbert and Cheryl D. Bankston *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p *(For primary document see N93-22226 08-12)*
Avail: CASI HC A01/MF A03

N93-22260*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DESIGN AND FABRICATION OF AN AUTONOMOUS RENDEZVOUS AND DOCKING SENSOR USING OFF-THE-SHELF HARDWARE Abstract Only
Gary E. Grimm (TRW, Inc., Redondo Beach, CA.), Thomas C. Bryan, Richard T. Howard, and Michael L. Book *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p *(For primary document see N93-22226 08-12)*
Avail: CASI HC A01/MF A03

N93-22262*# TRW, Inc., Houston, TX.
USE OF NON-SPHERICAL GRAVITY HARMONICS FOR RELATIVE MOTION GN/C (CATEGORY 2) Abstract Only
David M. Henderson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For

primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22263*# TRW, Inc., Houston, TX.
GN/C TRANSLATION AND ROTATION CONTROL PARAMETERS FOR AR/C (CATEGORY 2) Abstract Only
David M. Henderson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22265*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SOVIET AUTOMATED RENDEZVOUS AND DOCKING SYSTEM OVERVIEW Abstract Only
Elaine M. Hinman and David M. Bushman *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 4 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22275*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
PERFORMANCE CAPABILITIES OF A PHASE ONE AUTOMATIC RENDEZVOUS AND CAPTURE SYSTEM Abstract Only
Peter M. Kachmar, Robert J. Polutchko, and Martin Matusky *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22277*# United Technologies Corp., Huntsville, AL.
AUTOMATED RENDEZVOUS AND CAPTURE SYSTEM Abstract Only
Jack B. Kader, John H. Caulfield (Alabama Univ., Huntsville.), Chandra S. Vikram (Alabama Univ., Huntsville.), and Steve Patrick *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22286*# General Dynamics Corp., San Diego, CA. Space Systems Div.
DGPS FOR SPACE AND RETURN Abstract Only
Stanley C. Maki *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22287*# Lockheed Missiles and Space Co., Houston, TX.
AN AUTOMATED RENDEZVOUS AND CAPTURE SYSTEM DESIGN CONCEPT FOR THE CARGO TRANSFER VEHICLE AND SPACE STATION FREEDOM Abstract Only
Ron Fuchs and Steven Marsh *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22288*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SUPERVISED AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEMS TECHNOLOGY EVALUATIONS Abstract Only
Neville I. Marzwell *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
(RTOP 906-00-00)
Avail: CASI HC A01/MF A03

N93-22296*# McDonnell-Douglas Space Systems Co., Houston, TX.
SPACECRAFT RENDEZVOUS OPERATIONAL CONSIDERATIONS AFFECTING VEHICLE SYSTEMS DESIGN AND CONFIGURATION Abstract Only
Ellen E. Prust *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22300*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PROPOSED CTV DESIGN REFERENCE MISSIONS IN SUPPORT OF SPACE STATION FREEDOM Abstract Only
Rudy J. Saucillo (McDonnell-Douglas Space Systems Co., Rockville, MD.) and William M. Cirillo *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22306*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.
CONTACT DYNAMICS TESTING OF AUTOMATED THREE POINT DOCKING MECHANISM Abstract Only
Christopher J. Spitzer *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22308*# McDonnell-Douglas Space Systems Co., Houston, TX.
PROXIMITY OPERATIONS CONSIDERATIONS AFFECTING SPACECRAFT DESIGN Abstract Only
Steven K. Staas *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22311*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.
GUIDELINE REQUIREMENTS FOR SERVICEABLE SPACECRAFT GRASPING/BERTHING/DOCKING INTERFACES BASED ON SIMULATIONS AND FLIGHT EXPERIENCE (SURVEY PAPER) Abstract Only
Allen B. Thompson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22315*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONCURRENT-SCENE/ALTERNATE-PATTERN ANALYSIS FOR ROBUST VIDEO-BASED DOCKING SYSTEMS Abstract Only
Suraphol Udomkesmalee *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22317*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A BERTHING AND FASTENING STRATEGY FOR ORBITAL REPLACEMENT UNITS Abstract Only
John Vranish and Edward Cheung *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22319*# Lockheed Engineering and Sciences Co., Houston, TX. Man Systems/Human Factors Engineering Dept.
EMPLOYING LIGHTING TECHNIQUES DURING ON-ORBIT OPERATIONS Abstract Only
Charles D. Wheelwright and Jennifer R. Toole *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22321*# General Dynamics/Convair, San Diego, CA.
AR/D IMAGE PROCESSING SYSTEM Abstract Only
Cathy Wookey and Bruce Nicholson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-23809# European Space Agency. European Space Operations Center, Darmstadt (Germany). Mission Analysis Section.
THE SPACE DEBRIS ENVIRONMENT FOR REMOTE SENSING SATELLITES
H. Klinkrad *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1269-1275 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23821# Euroavia, Garbsen (Germany).
EUROAVIA DESIGN WORKSHOP 1991: ORGANIZATION AND LESSONS LEARNED
Cristian Bank and Norbert Pailer (Dornier System G.m.b.H., Friedrichshafen, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1317-1322 (For primary document see N93-23748 08-43)
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N93-23922# Dornier System G.m.b.H., Friedrichshafen (Germany).
CONCEPT OF A SMALL SATELLITE FOR URM
N. Pailer, G. Hampel, E. Bachor, H. Kunow (Kiel Univ., Germany.), and C. Bank (Euroavia, Stuttgart, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 201-203 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24338# Alenia Spazio S.p.A., Rome (Italy).
THE PROSPECTS OF THE COLUMBUS PROGRAMME TEN YEARS AFTER ITS INITIATION
Ernesto Vallerani *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 11-14 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24339# National Space Development Agency, Tokyo (Japan). Space Experiment Group.
JEM PROGRAM STATUS
Masatoshi Saito *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 15-18 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24349# Molnia Scientific-Industry Enterprise, Moscow (Russia).
THE EFFECT OF MISSIONS AND PAYLOAD PERFORMANCE ON THE CONFIGURATION OF AN ORBITAL INJECTION SYSTEM DESIGN
G. E. Lozino-Lozinsky, V. A. Skorodelov, Y. M. Kosinsky, and V. P. Plokhikh (Tsentralni Aerogidrodinamicheskii Inst., Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 73-77 (For primary document see N93-24336 08-12)
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N93-24377# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).
COMPASS: A COMPUTERIZED PAYLOAD OPERATIONS SUPPORT SYSTEM FOR COLUMBUS
D. Heyland, A. Kellner (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany.), and R. Timm (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 227-233 (For primary document see N93-24336 08-12)
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N93-24388# European Space Agency, Paris (France).
ATTACHED PAYLOAD ISSUES
G. P. Haskell *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 289-290 (For primary document see N93-24336 08-12)
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19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N93-23003*# Lockheed Engineering and Sciences Co., Houston, TX.
SPACE GENERIC OPEN AVIONICS ARCHITECTURE (SGOAA) STANDARD SPECIFICATION
Richard B. Wray and John R. Stovall Mar. 1993 59 p Revised Supersedes LESC-30354
(Contract NAS9-17900)
(NASA-CR-188245; NAS 1.26:188245; LESC-30354-A) Avail: CASI HC A04/MF A01

The purpose of this standard is to provide an umbrella set of requirements for applying the generic architecture interface model to the design of a specific avionics hardware/software system. This standard defines a generic set of system interface points to facilitate identification of critical interfaces and establishes the requirements for applying appropriate low level detailed implementation standards to those interface points. The generic core avionics system and processing architecture models provided herein are robustly tailorable to specific system applications and provide a platform upon which the interface model is to be applied. Derived from text

N93-23224*# Teledyne Brown Engineering, Huntsville, AL.
SPACE STATION FURNACE FACILITY. VOLUME 2: REQUIREMENTS DEFINITION AND CONCEPTUAL DESIGN STUDY. APPENDIX 3: ENVIRONMENT ANALYSIS Final Report
May 1992 318 p
(Contract NAS8-38077)
(NASA-CR-192475; NAS 1.26:192475) Avail: CASI HC A14/MF A03

A Preliminary Safety Analysis (PSA) is being accomplished as part of the Space Station Furnace Facility (SSFF) contract. This analysis is intended to support SSFF activities by analyzing concepts and designs as they mature to develop essential safety requirements for inclusion in the appropriate specifications, and designs, as early as possible. In addition, the analysis identifies significant safety concerns that may warrant specific trade studies or design definition, etc. The analysis activity to date concentrated on hazard and hazard cause identification and requirements development with the goal of developing a baseline set of detailed requirements to support trade study, specifications development, and preliminary design activities. The analysis activity will continue as the design and concepts mature. Section 2 defines what was analyzed, but it is likely that the SSFF definitions will undergo further changes. The safety analysis activity will reflect these changes as they occur. The analysis provides the foundation for later safety activities. The hazards identified will in most cases have Preliminary Design Review (PDR) applicability. The requirements and recommendations developed for each hazard will be tracked to ensure proper and early resolution of safety concerns. Author

N93-23225*# Teledyne Brown Engineering, Huntsville, AL. Space Programs Div.
SPACE STATION FURNACE FACILITY. VOLUME 1: REQUIREMENTS DEFINITION AND CONCEPTUAL DESIGN STUDY, EXECUTIVE SUMMARY

May 1992 36 p
(Contract NAS8-38077)
(NASA-CR-192471; NAS 1.26:192471) Avail: CASI HC A03/MF A01

The Space Station Freedom Furnace (SSFF) Study was awarded on June 2, 1989, to Teledyne Brown Engineering (TBE) to define an advanced facility for materials research in the microgravity environment of Space Station Freedom (SSF). The SSFF will be designed for research in the solidification of metals and alloys, the crystal growth of electronic and electro-optical materials, and research in glasses and ceramics. The SSFF is one of the first 'facility' class payloads planned by the Microgravity Science and Applications Division (MSAD) of the Office of Space Science and Applications of NASA Headquarters. This facility is planned for early deployment during man-tended operations of the SSF with continuing operations through the Permanently Manned Configuration (PMC). The SSFF will be built around a general 'Core' facility which provides common support functions not provided by SSF, common subsystems which are best centralized, and common subsystems which are best distributed with each experiment module. The intent of the facility approach is to reduce the overall cost associated with implementing and operating a variety of experiments. This is achieved by reducing the launch mass and simplifying the hardware development and qualification processes associated with each experiment. The Core will remain on orbit and will require only periodic maintenance and upgrading while new Furnace Modules, samples, and consumables are developed, qualified, and transported to the SSF. The SSFF Study was divided into two phases: phase 1, a definition study phase, and phase 2, a design and development phase. The definition phase 1 is addressed. Phase 1 was divided into two parts. In the first part, the basic part of the effort, covered the preliminary definition and assessment of requirements; conceptual design of the SSFF; fabrication of mockups; and the preparation for and support of the Conceptual Design Review (CoDR). The second part, the option part, covered requirements update and documentation; refinement of the selected conceptual design through additional trades and analyses; design, fabrication, and test of the Development Model; and design, fabrication, and test of the Interrack Demonstration Unit; and support of the requirements definition review (RDR). The purpose of part 2 was to prove concept feasibility. Author (revised)

N93-23237*# Teledyne Brown Engineering, Huntsville, AL. Space Programs Div.
SPACE STATION FURNACE FACILITY. VOLUME 3: PROGRAM COST ESTIMATE
May 1992 176 p
(Contract NAS8-38077)
(NASA-CR-192478; NAS 1.26:192478) Avail: CASI HC A09/MF A02

The approach used to estimate costs for the Space Station Furnace Facility (SSFF) is based on a computer program developed internally at Teledyne Brown Engineering (TBE). The program produces time-phased estimates of cost elements for each hardware component, based on experience with similar components. Engineering estimates of the degree of similarity or difference between the current project and the historical data is then used to adjust the computer-produced cost estimate and to fit it to the current project Work Breakdown Structure (WBS). The SSFF Concept as presented at the Requirements Definition Review (RDR) was used as the base configuration for the cost estimate. This program incorporates data on costs of previous projects and the allocation of those costs to the components of one of three, time-phased, generic WBS's. Input consists of a list of similar components for which cost data exist, number of interfaces with their type and complexity, identification of the extent to which previous designs are applicable, and programmatic data concerning schedules and miscellaneous data (travel, off-site assignments). Output is program cost in labor hours and material dollars, for each component, broken down by generic WBS task and program schedule phase. Derived from text

N93-23238*# Teledyne Brown Engineering, Huntsville, AL. Space Programs Div.
SPACE STATION FURNACE FACILITY. VOLUME 2: REQUIREMENTS DEFINITION AND CONCEPTUAL DESIGN STUDY Final Technical Report
May 1992 52 p Original contains color illustrations
(Contract NAS8-38077)
(NASA-CR-192472; NAS 1.26:192472) Avail: CASI HC A04/MF A01; 2 functional color pages

The Space Station Freedom Furnace (SSFF) Project is divided into two phases: phase 1, a definition study phase, and phase 2, a design and development phase. TBE was awarded a research study entitled, 'Space Station Furnace Facility Requirements Definition and Conceptual Design Study' on June 2, 1989. This report addresses the definition study phase only. Phase 2 is to be complete after completion of phase 1. The contract encompassed a requirements definition study and culminated in hardware/facility conceptual designs and hardware demonstration development models to test these conceptual designs. The study was divided into two parts. Part 1 (the basic part of the effort) encompassed preliminary requirements definition and assessment; conceptional design of the SSFF Core; fabrication of mockups; and preparation for the support of a conceptional design review (CoDR). Part 2 (the optional part of the effort) included detailed definition of the engineering and design requirements, as derived from the science requirements; refinement of the conceptual design of the SSFF Core; fabrication and testing of the 'breadboards' or development models; and preparation for and support of a requirements definition review. Derived from text

N93-23241*# Teledyne Brown Engineering, Huntsville, AL.
SPACE STATION FURNACE FACILITY. EXPERIMENT/FACILITY REQUIREMENTS DOCUMENT (E/FRD), VOLUME 2, APPENDIX 5 Final Report
Nancy Kephart May 1992 354 p Original contains color illustrations
(Contract NAS8-38077)
(NASA-CR-192476; NAS 1.26:192476; Rept-320REQ0007-Vol-2-App-5)
Avail: CASI HC A16/MF A03; 2 functional color pages

The function of the Space Station Furnace Facility (SSFF) is to support materials research into the crystal growth and solidification processes of electronic and photonic materials, metals and alloys, and glasses and ceramics. To support this broad base of research requirements, the SSFF will employ a variety of furnace modules operated, regulated, and supported by a core of common subsystems. Furnace modules may be reconfigured or specifically developed to provide unique solidifcation conditions for each set of experiments. The SSFF modular approach permits the addition of new or scaled-up furnace modules to support the evolution of the facility as new science requirements are identified. The SSFF Core is of modular design to permit augmentation for enhanced capabilities. The fully integrated configuration of the SSFF will consist of three racks with the capability of supporting up to two furnace modules per rack. The initial configuration of the SSFF will consist of two of the three racks and one furnace module. This Experiment/Facility Requirements Document (E/FRD) describes the integrated facility requirements for the Space Station Freedom (SSF) Integrated Configuration-1 (IC1) mission. The IC1 SSFF will consist of two racks: the Core Rack, with the centralized subsystem equipment, and the Experiment Rack-1, with Furnace Module-1 and the distributed subsystem equipment to support the furnace. Derived from text

N93-23389# European Space Agency. ESRIN, Frascati (Italy). Earthnet.
ESA ERS 1 PRODUCT SPECIFICATION
Pam Vass, ed. and Bruce Battrick, ed. Jun. 1992 71 p Original contains color illustrations
(ESA-SP-1149; ISBN-92-9092-033-5; ETN-93-93498) Copyright Avail: CASI HC A04/MF A01; ESA, EPD, ESTEC, Noorwijk, Netherlands, HC

Information relevant to the description of the product generated from the data telemetered by the ERS-1 payload instruments at ESA facilties (ground stations or processing and archiving facilities) is presented. ERS-1 is the first European remote sensing satellite launched by ESA on 17 Jul. 1991, and in the three years of its expected lifetime will provide systematic coverage of ocean and sea ice areas on a highly repetitive basis allowing global monitoring for meteorological and environmental applications. Much of the data will be collected from remote areas such as the polar regions and the southern oceans, for which little comparable information has previously been collected. The nature of the satellite's orbit and its complement of sensors enables a global mission providing worldwide geographical and repetitive coverage, primarily oriented towards ocean and ice monitoring. An all weather high resolution microwave imaging capability is also available over land and coastal zones within the regional coverage of a ground receiving station. The ERS-1 space segment, ground segment,

and user access to products and services are introduced. Summaries of characteristics and available product specifications are given for the following instruments: Synthetetic Aperture Radar (SAR) image mode, SAR wave mode, wind scatterometer, and radio altimeter. Details of the orbit and gravity field models are given. ESA

N93-23407*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SUMS EXPERIMENT FLIGHT RESULTS ON STS-35
Robert C. Blanchard, Thomas A. Ozoroski (Vigyan Research Associates, Inc., Hampton, VA.), and John Y. Nicholson (Vigyan Research Associates, Inc., Hampton, VA.) Apr. 1993 33 p Original contains color illustrations
(RTOP 506-48-11-03)
(NASA-TM-107738; NAS 1.15:107738) Avail: CASI HC A03/MF A01; 2 functional color pages

Calibrated pressure measurements for species with mass to charge ratios up to 50 amu/e(-) were obtained from the Shuttle Upper Atmosphere Mass Spectrometer (SUMS) experiment during reentry on the STS-35 mission. Data were collected from 180 km, when the signal rose above the background, to about 87 km, when the SUMS system automatically closed the gas inlet value. However, data above 115 km was contaminated from a source of gas emanating from pressure transducers connected in parallel to the mass spectrometer. At lower altitudes, the pressure transducer data is compared with the mass spectrometer total pressure with excellent agreement. The free-stream density in the rarefied flow flight regime is calculated using an orifice pressure coefficient model based upon direct simulation Monte Carlo results. This density, when compared with the 1976 U.S. standard atmosphere model, exhibits the wave-like nature seen on previous flights using accelerometry. In addition, selected spectra are presented at higher altitudes (320 km) showing the effects of the ingestion of gases from a forward fuselage fuel dump. An analysis of the spectra data from this event is presented to show that no significant permanent changes occurred which affected the data interpretation at lower altitudes. Further, the localized chemistry from the individual species during the onset of aerodynamic heating is examined to the extent possible for a closed source system, such as SUMS. Near the orifice entrance, a significant amount of CO2 was generated from chemical reactions with the carbon panels of the Orbiter and absorbed oxygen on the system tubing.
Author (revised)

N93-23738*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PROPOSED GROUND-BASED CONTROL OF ACCELEROMETER ON SPACE STATION FREEDOM
Richard DeLombard May 1993 15 p Proposed for presentation at the 39th International Instrumentation Symposium, Albuquerque, NM, 2-6 May 1993; sponsored by the Instrument Society of America Original contains color illustrations
(RTOP 694-03-0H)
(NASA-TM-105960; E-7478; NAS 1.15:105960) Avail: CASI HC A03/MF A01; 1 functional color page

This paper describes the innovative control of an accelerometer to support the needs of the scientists operating science experiments that are on-board Space Station Freedom (SSF). Accelerometers in support of science experiments on the shuttle have typically been passive, record-only devices that present data only after the mission or that present limited data to the crew or ground operators during the mission. With the advent of science experiment operations on SSF, the principal investigators will need microgravity acceleration data during, as well as after, experiment operations. Because their data requirements may change during the experiment operations, the principal investigators will be allocated some control of accelerometer parameters. This paper summarizes the general-purpose Space Acceleration Measurement System (SAMS) operation that supports experiments on the shuttle and describes the control of the SAMS for Space Station Freedom. Emphasis is placed on the proposed ground-based control of the accelerometer by the principal investigators.
Author

N93-24280# California Univ., Berkeley. Space Sciences Lab.
PREPARATION FOR ANALYSIS OF DATA FROM THE LANGMUIR PROBE INSTRUMENT ON THE CRRES SATELLITE Final Report, 17 Mar. 1987 - 17 Jun. 1992
Forrest S. Mozer 10 Sep. 1992 59 p
(Contract F19628-87-K-0016)
(AD-A260534; AD-E201392; PL-TR-92-2240) Avail: CASI HC A04/MF A01

The Langmuir Probe/Electric Field Experiment was designed, built, and flown on the CRRES satellite to obtain high quality measurements of plasma density, electric fields, and waves in the inner magnetosphere. A data reduction and display program was written and initial results were reported. The spacecraft failed after more than one year of successful data collection. GRA

N93-22256*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
IMAGE BASED TRACKING APPROACHES TO AR/C AT THE JOHNSON SPACE CENTER Abstract Only
Timothy E. Fisher and Alan T. Smith (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22267*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
VIDEO GUIDANCE SENSOR FOR AUTONOMOUS CAPTURE Abstract Only
Richard T. Howard and Michael L. Book *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22291*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MAGNETIC END EFFECTORS FOR SPACE OPERATIONS Abstract Only
Leo Monford and Edward L. Carter (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22303*# Martin Marietta Corp., Denver, CO. Astronautics Group.
PHOTONIC CORRELATOR PATTERN RECOGNITION: APPLICATION TO AUTONOMOUS DOCKING Abstract Only
Gary W. Sjolander *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22314*# McDonnell-Douglas Space Systems Co., Huntington Beach, CA. Advanced Products Development and Technology Div.
ELECTRO-OPTICAL RENDEZVOUS AND DOCKING SENSORS Abstract Only
David J. Tubbs, Lynn O. Kesler, and Robert J. Sirko *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-23532# Jena-Optronik G.m.b.H. (Germany).
A STAR PATTERN RECOGNITION SENSOR (SPRS) OF HIGH ACCURACY: A CONTRIBUTION TO NEW POSSIBILITIES OF AUTONOMOUS ATTITUDE DETERMINATION
W. Skarus, D. Ratzsch, and C. Elstner *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 135-139 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24360# Technische Univ., Graz (Austria). Inst. for Communications and Wave Propagation.
MIGMAS/A: TEST OF A SCANNING ION MICROSCOPE ONBOARD THE SOVIET SPACE STATION MIR
W. Riedler, F. G. Ruedenauer (Austrian Research Center, Seibersdorf.), P. Beck (Austrian Research Center, Seibersdorf.), V. Berzhatyi (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), M. Fehringer (Austrian Research Center, Seibersdorf.), R. Finsterbusch, L. Neznamova (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), R. Pammer, F. Puerstl, and W. Steiger (Austrian Research Center, Seibersdorf.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 127-131 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24387# Padua Univ. (Italy). Center of Studies and Activities for Space.
EUROPEAN SPACE SCIENCE AND SPACE STATION FREEDOM
P. L. Bernacca *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 285-288 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24397# Academy of Sciences of the Latvian SSR, Riga. Physics Inst.
A THERMAL TYPE PROBE FOR LOW VELOCITY MEASUREMENTS
L. Gorbunov and V. Kolevzon *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 339-340 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N93-22012*# Remtech, Inc., Huntsville, AL.
NLS CYCLE 1 AND NLS 2 BASE HEATING TECHNICAL NOTES. APPENDIX 3: PRELIMINARY CYCLE 1 NLS BASE HEATING ENVIRONMENTS. CYCLE 1 NLS BASE HEATING ENVIRONMENTS. NLS 2 650K STME BASE HEATING ENVIRONMENTS
Robert L. Bender, John E. Reardon, Maurice J. Prendergast, Craig P. Schmitz, and John R. Brown 1992 174 p
(Contract NAS8-38141)
(NASA-CR-192454; NAS 1.26:192454; RTN-218-01; RTN-218-03; RTN-218-04; RTN-250-6-01) Avail: CASI HC A08/MF A02

A preliminary analysis of National Launch System ascent plume induced base heating environments has been completed to support the Induced Environments Panel's objective to assist in maturing the NLS vehicle (1.5 stage and heavy launch lift vehicle) design. Environments during ascent have been determined from this analysis for a few selected locations on the engine nozzles and base heat shield for both vehicles. The environments reflect early summer 1991 configurations and performance data and conservative methodology. A more complete and thorough analysis is under way to update these environments for the cycle 1 review in January 1992. Author

N93-22014*# Texas Univ. at Dallas, Richardson. Center for Space Sciences.
DEVELOPMENT OF A MINIATURE MASS ANALYZER AND ASSOCIATED INSTRUMENTATION FOR IMPROVED CAPABILITIES IN THE ANALYSIS OF LOW ENERGY PLASMAS FROM A ROCKET OR SATELLITE PLATFORM Final Technical Report, 12 Dec. 1988 - 31 May 1992
John H. Hoffman 20 Jul. 1992 4 p
(Contract NAS8-37582)
(NASA-CR-192453; NAS 1.26:192453) Avail: CASI HC A01/MF A01

The University of Texas at Dallas (UTD) Center for Space Sciences (CSS) has designed, developed, and fabricated three miniature mass spectrometers and their associated instrumentation in fulfillment of a NASA contract. The ion mass spectrometer analyzers furnished under this contract were modeled after a unit developed during a previous NASA grant. Three assemblies are described: (1) the magnetic sector; (2) the ion detector; and (3) the amplifier and power supply. Derived from text

N93-22350*# Remtech, Inc., Huntsville, AL.
BASE HEATING METHODOLOGY IMPROVEMENTS, VOLUME 1 Final Report, Sep. 1989 - Nov. 1992
Robert L. Bender, John E. Reardon, Richard E. Somers, Michael S. Fulton, Sheldon D. Smith (SECA, Inc., Huntsville, AL.), and Harold Pergament (Propulsion Science and Technology, Inc., Princeton, NJ.) Nov. 1992 112 p
(Contract NAS8-38141)
(NASA-CR-192455; NAS 1.26:192455; RTR-218-01-Vol-1) Avail: CASI HC A06/MF A02

This document is the final report for NASA MSFC Contract NAS8-38141. The contracted effort had the broad objective of improving the launch vehicles ascent base heating methodology to improve and simplify the determination of that environment for Advanced Launch System (ALS) concepts. It was pursued as an Advanced Development Plan (ADP) for the Joint DoD/NASA ALS program office with project management assigned to NASA/MSFC. The original study was to be completed in 26 months beginning Sep. 1989. Because of several program changes and emphasis on evolving launch vehicle concepts, the period of performance was extended to the current completion date of Nov. 1992. A computer code incorporating the methodology improvements into a quick prediction tool was developed and is operational for basic configuration and propulsion concepts. The code and its users guide are also provided as part of the contract documentation. Background information describing the specific objectives, limitations, and goals of the contract is summarized. A brief chronology of the ALS/NLS program history is also presented to provide the reader with an overview of the many variables influencing the development of the code over the past three years. Author

N93-22382*# Alabama Univ., Huntsville.
TURBULENCE MODELLING OF FLOW FIELDS IN THRUST CHAMBERS Final Technical Report, 10 Jun. 1991 - 13 Sep. 1992
C. P. Chen, Y. M. Kim, and H. M. Shang Feb. 1993 53 p
(Contract NAS8-36955)
(NASA-CR-192466; NAS 1.26:192466; UAH-5-32688) Avail: CASI HC A04/MF A01

Following the consensus of a workshop in Turbulence Modelling for Liquid Rocket Thrust Chambers, the current effort was undertaken to study the effects of second-order closure on the predictions of thermochemical flow fields. To reduce the instability and computational intensity of the full second-order Reynolds Stress Model, an Algebraic Stress Model (ASM) coupled with a two-layer near wall treatment was developed. Various test problems, including the compressible boundary layer with adiabatic and cooled walls, recirculating flows, swirling flows, and the entire SSME nozzle flow were studied to assess the performance of the current model. Detailed calculations for the SSME exit wall flow around the nozzle manifold were executed. As to the overall flow predictions, the ASM removes another assumption for appropriate comparison with experimental data to account for the non-isotropic turbulence effects. Author (revised)

N93-22411# Sandia National Labs., Albuquerque, NM.
TEST FACILITIES FOR EVALUATING NUCLEAR THERMAL PROPULSION SYSTEMS
D. F. Beck, G. C. Allen, L. R. Shipers, D. Dobranich, C. A. Ottinger, C. D.

Harmon, W. C. Fan, and M. Todosow (Brookhaven National Lab., Upton, NY.) 22 Sep. 1992 16 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993
(Contract DE-AC04-76DP-00789)
(DE93-002468; SAND-92-2009C; CONF-930103-17) Avail: CASI HC A03/MF A01

Interagency panels evaluating nuclear thermal propulsion (NTP) development options have consistently recognized the need for constructing a major new ground test facility to support fuel element and engine testing. This paper summarizes the requirements, configuration, and baseline performance of some of the major subsystems designed to support a proposed ground test complex for evaluating nuclear thermal propulsion fuel elements and engines being developed for the Space Nuclear Thermal Propulsion (SNTP) program. Some preliminary results of evaluating this facility for use in testing other NTP concepts are also summarized. DOE

N93-22482*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
100-kW CLASS APPLIED-FIELD MPD THRUSTER COMPONENT WEAR
Maris A. Mantenieks and Roger M. Myers (Sverdrup Technology, Inc., Brook Park, OH.) Jan. 1993 12 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993; sponsored by the University of New Mexico
(RTOP 506-42-31)
(NASA-TM-106023; E-7586; NAS 1.15:106023) Avail: CASI HC A03/MF A01

Component erosion and material deposition sites were identified and analyzed during tests of various configurations of 100 kW class, applied-field, water-cooled magnetoplasmadynamic (MPD) thrusters. Severe erosion of the cathode and the boron nitride insulator was observed for the first series of tests, which was significantly decreased by reducing the levels of propellant contamination. Severe erosion of the copper anode resulting from sputtering by the propellant was also observed. This is the first observation of this phenomenon in MPD thrusters. The anode erosion indicates that development of long life MPD thrusters requires the use of light gas propellants such as hydrogen, deuterium, or lithium. Author

N93-22501# Sandia National Labs., Albuquerque, NM.
A REACTOR-PUMPED LASER AS PRIMARY POWER FOR NUCLEAR ROCKET ENGINES
D. K. Monroe and J. V. Walker 1992 16 p Presented at the Confederation of Independent States (CIS) Conference on Nuclear Thermal Propulsion, Semipalatinsk, Russia, 21 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005342; SAND-92-2205C; CONF-9209287-1) Avail: CASI HC A03/MF A01

During the last two decades there has been considerable interest in developing alternatives to conventional chemical propulsion for space missions. Laser propulsion has been identified as a serious contender for the task of inexpensively delivering small payloads to low-earth orbit. Recent advances in the development of lasers powered directly by nuclear reaction products offer the potential for new propulsion methods, namely, reactor-laser propulsion. Such systems would allow 'nuclear propulsion' without placing nuclear systems in space. DOE

N93-22662*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.
HEAT PIPE HEAT TRANSPORT SYSTEM FOR THE STIRLING SPACE POWER CONVERTER (SSPC)
Donald L. Alger Cleveland, Ohio Aug. 1992 11 p Presented at the 27th Intersociety Energy Conversion Engineering Conference, San Diego, CA, 3-7 Aug. 1992; sponsored by the SAE, ACS, AIAA, ASME, IEEE, AIChE, and ANS
(Contract NAS3-25266; RTOP 590-13-11)
(NASA-CR-191065; E-7118; NAS 1.26:191065) Avail: CASI HC A03/MF A01

Life issues relating to a sodium heat pipe heat transport system are described. The heat pipe system provides heat, at a temperature of 1050 K, to a 50 kWe Stirling engine/linear alternator power converter called the Stirling Space Power Converter (SSPC). The converter is being developed under a National Aeronautics and Space Administration program. Since corrosion of heat pipe materials in contact with sodium can impact the life of the heat pipe, a literature review of sodium corrosion processes was performed. It was found that the impurity reactions, primarily oxygen, and dissolution of alloy elements were the two corrosion process likely to be operative in the heat pipe. Approaches that are being taken to minimize these corrosion processes are discussed. Author

N93-22674*# Ultramet Co., Pacoima, CA.
LIGHTWEIGHT SOLAR CONCENTRATOR STRUCTURES, PHASE 2 Final Report
Brian E. Williams and Richard B. Kaplan Feb. 1993 25 p
(Contract NAS3-25418; RTOP 506-41-31)
(NASA-CR-191068; E-7576; NAS 1.26:191068) Avail: CASI HC A03/MF A01

This report summarizes the results of the program conducted by Ultramet under SBIR Phase 2 Contract NAS3-25418. The objective of this program was to develop lightweight materials and processes for advanced high accuracy Space Solar Concentrators using rigidized foam for the substrate structure with an integral optical surface. Author (revised)

N93-22962*# Remtech, Inc., Huntsville, AL.
USER'S MANUAL FOR THE ALS BASE HEATING PREDICTION CODE, VOLUME 2
John E. Reardon and Michael S. Fulton Nov. 1992 30 p
(Contract NAS8-38141)
(NASA-CR-192457; NAS 1.26:192457; RTR-218-01-Vol-2) Avail: CASI HC A03/MF A01

The Advanced Launch System (ALS) Base Heating Prediction Code is based on a generalization of first principles in the prediction of plume induced base convective heating and plume radiation. It should be considered to be an approximate method for evaluating trends as a function of configuration variables because the processes being modeled are too complex to allow an accurate generalization. The convective methodology is based upon generalizing trends from four nozzle configurations, so an extension to use the code with strap-on boosters, multiple nozzle sizes, and variations in the propellants and chamber pressure histories cannot be precisely treated. The plume radiation is more amenable to precise computer prediction, but simplified assumptions are required to model the various aspects of the candidate configurations. Perhaps the most difficult area to characterize is the variation of radiation with altitude. The theory in the radiation predictions is described in more detail. This report is intended to familiarize a user with the interface operation and options, to summarize the limitations and restrictions of the code, and to provide information to assist in installing the code. Author

N93-22963*# Remtech, Inc., Huntsville, AL.
PRELIMINARY BASE HEATING ENVIRONMENTS FOR A GENERALIZED ALS LO2/LH2 LAUNCH VEHICLE, APPENDIX 1 AND 2
Robert L. Bender and John E. Reardon 19 Oct. 1989 352 p
(Contract NAS8-39141)
(NASA-CR-192456; NAS 1.26:192456; RTN-218-01-App-1-2; RL-91-61-ATT-9.1-App-1-2) Avail: CASI HC A16/MF A03

A secondary objective of contract NAS8-39141 is to provide base heating assessments, as required, to support Advanced Launch System (ALS) preliminary launch vehicle and propulsion system design studies. The ALS propulsion systems integration working group meeting (No. 3) recently completed in San Diego, California, focused attention on the need for base heating environment determination to provide preliminary requirements for LO2/LH2 propulsion systems currently being considered for ALS. We were requested to provide these environments for a range of possible propellant mixture and nozzle area ratios. Base heating environments can only be determined as a function of altitude when the engine operating conditions and vehicle base region geometry (engine arrangement) are known. If time dependent environments are needed to assess thermal loads, a trajectory must also be provided. These parameters are not fixed at this time since the ALS configurations and propulsion operating conditions are varied and continue to be studied by Phase B contractors. Therefore, for this study, a generalized LO2/LH2 system was selected along with a vehicle configuration consisting of a seven-engine booster and a three-engine core. MSFC provided guidance for the selection. We also selected a limited number of body points on the booster and core vehicles and engines for the environment estimates. Environments at these locations are representative of maximum heating conditions in the

base region and are provided as a function of altitude only. Guidelines and assumptions for this assessment, methodology for determining the environments, and preliminary results are provided in this technical note. Refinements in the environments will be provided as the ALS design matures. Author

N93-22998# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.
TERMINOLOGY AND ASSESSMENT METHODS OF SOLID PROPELLANT ROCKET EXHAUST SIGNATURES [METHODES D'EVALUATION DES SIGNATURES DES PROPULSEURS A PROPERGOL SOLIDE]
Feb. 1993 271 p
(AGARD-AR-287; ISBN-92-835-0699-5) Copyright Avail: CASI HC A12/MF A03

The Propulsion and Energetics Panel's Specialists' Meeting in autumn 1985 on Smokeless Propellants demonstrated that no common standard was available in this field and that the lack of common understanding led to misunderstanding amongst the NATO community. After some preparatory discussion, the Panel, therefore, formed Working Group Number 21 with the objectives of defining methods for the assessment of rocket motor exhaust optical properties in the visible and in the infrared range, and of recommending a terminology based on quantitative criteria. The Working Group discussed the subject in a total of eight sessions and prepared this Advisory Report. Following an Introduction and Summary there are six chapters, commencing with an Overview and continuing with Propellant Smoke Classification, Plume Primary Smoke, Plume Secondary Smoke, Plume Radiation and Plume Microwave Properties. In most cases, the conclusions and recommendations follow the chapters and are not repeated at the end of the report. Author (revised)

N93-23017*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SOLAR CONCENTRATORS FOR ADVANCED SOLAR-DYNAMIC POWER SYSTEMS IN SPACE Final Report
Richard Rockwell (Hughes Danbury Optical Systems, Inc., CT.) Mar. 1993 50 p
(Contract NAS3-25280; RTOP 506-41-31)
(NASA-CR-187148; E-7712; NAS 1.26:187148) Avail: CASI HC A03/MF A01

This report summarizes the results of a study performed by Hughes Danbury Optical Systems, HDOS, (formerly Perkin-Elmer) to design, fabricate, and test a lightweight (2 kg/sq M), self supporting, and highly reflective sub-scale concentrating mirror panel suitable for use in space. The HDOS panel design utilizes Corning's 'micro sheet' glass as the top layer of a composite honeycomb sandwich. This approach, whose manufacturability was previously demonstrated under an earlier NASA contract, provides a smooth (specular) reflective surface without the weight of a conventional glass panel. The primary result of this study is a point design and it's performance assessment. Author

N93-23405*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE CHEMICAL PROPULSION TEST FACILITIES AT NASA LEWIS RESEARCH CENTER
Donald C. Urasek and Frederick D. Calfo Apr. 1993 13 p Proposed for presentation at the Aerospace Atlantic Conference, Dayton, OH, 20-23 Apr. 1993; sponsored by SAE
(RTOP 584-03-11)
(NASA-TM-106050; E-7640; NAS 1.15:106050) Avail: CASI HC A03/MF A01

The NASA Lewis Research Center, located in Cleveland, Ohio, has a number of space chemical propulsion test facilities which constitute a significant national space testing resource. The purpose of this paper is to make more users aware of these test facilities and to encourage their use through cooperative agreements between the government, industry, and universities. Research which is of interest to the government is especially encouraged and often can be done in a cooperative manner that best uses the resources of all parties. An overview of the Lewis test facilities is presented. Author (revised)

N93-23747*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF ARCJET AND ION PROPULSION FOR SPACECRAFT STATIONKEEPING
James S. Sovey, Francis M. Curran, Thomas W. Haag, Michael J. Patterson, Eric J. Pencil, Vincent K. Rawlin, and John M. Sankovic Aug. 1992 17 p Presented at the 43rd Congress of the International Astronautical Federation, Washington, DC, 28 Aug. - 5 Sep. 1992; sponsored by COSPAR, IAF, and AIAA Previously announced in IAA as A92-57058
(RTOP 506-42-31)
(NASA-TM-106102; E-7722; NAS 1.15:106102; IAF-92-0607) Avail: CASI HC A03/MF A01

Near term flight applications of arc jet and ion thruster satellite station-keeping systems as well as development activities in Europe, Japan, and the United States are reviewed. At least two arc jet and three ion propulsion flights are scheduled during the 1992-1995 period. Ground demonstration technology programs are focusing on the development of kW-class hydrazine and ammonia arc jets and xenon ion thrusters. Recent work at NASA LeRC on electric thruster and system integration technologies relating to satellite station keeping and repositioning will also be summarized. Author (revised)

N93-23875*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUCLEAR ENGINE SYSTEM SIMULATION (NESS). VERSION 2.0: PROGRAM USER'S GUIDE Final Report
Dennis G. Pelaccio (Science Applications International Corp., Torrance, CA.), Christine M. Scheil (Science Applications International Corp., Torrance, CA.), and Lyman Petrosky (Science Applications International Corp., Torrance, CA.) Mar. 1993 312 p
(Contract NAS3-25809; RTOP 593-71-00)
(NASA-CR-191081; E-7623; NAS 1.26:191081) Avail: CASI HC A14/MF A03

This Program User's Guide discusses the Nuclear Thermal Propulsion (NTP) engine system design features and capabilities modeled in the Nuclear Engine System Simulation (NESS): Version 2.0 program (referred to as NESS throughout the remainder of this document), as well as its operation. NESS was upgraded to include many new modeling capabilities not available in the original version delivered to NASA LeRC in Dec. 1991, NESS's new features include the following: (1) an improved input format; (2) an advanced solid-core NERVA-type reactor system model (ENABLER 2); (3) a bleed-cycle engine system option; (4) an axial-turbopump design option; (5) an automated pump-out turbopump assembly sizing option; (6) an off-design gas generator engine cycle design option; (7) updated hydrogen properties; (8) an improved output format; and (9) personal computer operation capability. Sample design cases are presented in the user's guide that demonstrate many of the new features associated with this upgraded version of NESS, as well as design modeling features associated with the original version of NESS. Author (revised)

N93-23876*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUCLEAR ENGINE SYSTEM SIMULATION (NESS). VOLUME 1: PROGRAM USER'S GUIDE Final Report
Dennis G. Pelaccio (Science Applications International Corp., Torrance, CA.), Christine M. Scheil (Science Applications International Corp., Torrance, CA.), and Lyman J. Petrosky (Science Applications International Corp., Torrance, CA.) Mar. 1993 125 p
(Contract NAS3-25809; RTOP 593-71-00)
(NASA-CR-191080; E-7622; NAS 1.26:191080) Avail: CASI HC A06/MF A02

A Nuclear Thermal Propulsion (NTP) engine system design analysis tool is required to support current and future Space Exploration Initiative (SEI) propulsion and vehicle design studies. Currently available NTP engine design models are those developed during the NERVA program in the 1960's and early 1970's and are highly unique to that design or are modifications of current liquid propulsion system design models. To date, NTP engine-based liquid design models lack integrated design of key NTP engine design features in the areas of reactor, shielding, multi-propellant capability, and multi-redundant pump feed fuel systems. Additionally, since the SEI effort is in the initial development stage, a robust, verified NTP analysis design tool could be of great use to the community. This effort

developed an NTP engine system design analysis program (tool), known as the Nuclear Engine System Simulation (NESS) program, to support ongoing and future engine system and stage design study efforts. In this effort, Science Applications International Corporation's (SAIC) NTP version of the Expanded Liquid Engine Simulation (ELES) program was modified extensively to include Westinghouse Electric Corporation's near-term solid-core reactor design model. The ELES program has extensive capability to conduct preliminary system design analysis of liquid rocket systems and vehicles. The program is modular in nature and is versatile in terms of modeling state-of-the-art component and system options as discussed. The Westinghouse reactor design model, which was integrated in the NESS program, is based on the near-term solid-core ENABLER NTP reactor design concept. This program is now capable of accurately modeling (characterizing) a complete near-term solid-core NTP engine system in great detail, for a number of design options, in an efficient manner. The following discussion summarizes the overall analysis methodology, key assumptions, and capabilities associated with the NESS presents an example problem, and compares the results to related NTP engine system designs. Initial installation instructions and program disks are in Volume 2 of the NESS Program User's Guide. Author

N93-24025# Arnold Engineering Development Center, Arnold AFS, TN.
DEVELOPMENT OF A LASER-INDUCED FLUORESCENCE SYSTEM FOR APPLICATION TO ROCKET PLUMES Final Report, Oct. 1987 - Apr. 1992
C. W. Brasier and R. G. Porter Jan. 1993 48 p Prepared in cooperation with Sverdrup Technology, Inc., Tullahoma, TN
(AD-A259760; AEDC-TR-92-6) Avail: CASI HC A03/MF A01

The status of a continuous wave scanning ring-dye laser-induced fluorescence system is presented. This system was developed for measurements of velocity, temperature, pressure, and specie concentration in high-speed, high-temperature gas flows. Basic principles of laser-induced fluorescence of the sodium atom are discussed. Results of laboratory studies on a sodium vapor cell are presented. Application of this system to three full-scale liquid-propellant rocket engines is discussed, and initial results are presented. GRA

N93-24205 National Research Council of Canada, Ottawa (Ontario).
AC/DC CONVERTER Patent
Praveen K. Jain, inventor (to National Research Council of Canada 4 Aug. 1992 26 p Filed 6 Jul. 1989
(CA-Patent-1-306-005; Int-Patent-Class-H02M-7/06; CTN-93-60689)
Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC

In a system such as a 20 kHz space station primary electrical power distribution system, power conversion from AC to DC is required. Some of the basic requirements for this conversion are high efficiency, light weight and small volume, regulated output voltage, close to unity input power factor, distortionless input current, soft-starting, low electromagnetic interference, and high reliability. An AC-to-DC converter is disclosed which satisfies the main design objectives of such converters for use in space. The converter of the invention comprises an input transformer, a resonant network, a current controller, a diode rectifier, and an output filter. The input transformer is for connection to a single phase, high frequency, sinusoidal waveform AC voltage source and provides a matching voltage isolating from the AC source. The resonant network converts this voltage to a sinusoidal, high frequency bidirectional current output, which is received by the current controller to provide the desired output current. The diode rectifier is connected in parallel with the current controller to convert the bidirectional current into a unidirectional current output. The output filter is connected to the rectifier to provide an essentially ripple-free, substantially constant voltage DC output. CISTI

N93-24497# Brookhaven National Lab., Upton, NY.
APPLICABILITY OF TRENDS IN NUCLEAR SAFETY ANALYSIS TO SPACE NUCLEAR POWER SYSTEMS
R. A. Bari 1 Oct. 1992 4 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993
(Contract DE-AC02-76CH-00016)
(DE93-003169; BNL-48054; CONF-930103-19) Avail: CASI HC A01/MF A01

A survey is presented of some current trends in nuclear safety analysis that may be relevant to space nuclear power systems. This includes the following: lessons learned from operating power reactor safety and licensing; approaches to the safety design of advanced and novel reactors and facilities; the roles of risk assessment, extremely unlikely accidents, safety goals/targets; and risk-benefit analysis and communication. DOE

N93-24536*# Large Scale Programs Inst., Austin, TX.
A TRAJECTORY GENERATION AND SYSTEM CHARACTERIZATION MODEL FOR CISLUNAR LOW-THRUST SPACECRAFT. VOLUME 1: USER'S MANUAL Final Report (Diskette Supplement)
David J. Korsmeyer, Elfego Pinon, III, Brendan M. OConnor, and Curt R. Bilby May 1990 53 p Diskette supplement: 2 IBM compatible 5.25-inch DSDD diskettes
(Grant NAG3-928; RTOP 506-64-12)
(NASA-CR-185171; NAS 1.26:185171; LSPI-902-Vol-1; NONP-Suppl-DK-93-159803) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A13

The documentation of the Trajectory Generation and System Characterization Model for the Cislunar Low-Thrust Spacecraft is presented in Technical and User's Manuals. The system characteristics and trajectories of low-thrust nuclear electric propulsion spacecraft can be generated through the use of multiple system technology models coupled with a high-fidelity trajectory generation routine. The Earth to Moon trajectories utilize near Earth orbital plane alignment, midcourse control dependent upon the spacecraft's Jacobian constant, and capture to target orbit utilizing velocity matching algorithms. The trajectory generation is performed in a perturbed two-body equinoctial formulation and the restricted three-body formulation. A single control is determined by the user for the interactive midcourse portion of the trajectory. The full spacecraft system characteristics and trajectory are provided as output. The software is included on two floppy disks. Author

N93-22090*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CSTI EARTH-TO-ORBIT PROPULSION RESEARCH AND TECHNOLOGY PROGRAM OVERVIEW
Steven J. Gentz *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 119-130 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

N93-22091*# Aerojet-General Corp., Sacramento, CA. Propulsion Div.
ADVANCED ROCKET PROPULSION
Charles J. OBrien *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 131-137 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

N93-22092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE PROPULSION
John M. Kazaroff *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 138-142 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

N93-22093*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUCLEAR CONCEPTS/PROPULSION
Thomas J. Miller *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 143-147 (For primary document see N93-22081 08-16)
Avail: CASI HC A01/MF A04

N93-22094*# Thiokol Corp., Huntsville, AL. Space Operations.
SOLID ROCKET MOTORS
Ronn L. Carpenter *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 148-164 (For primary document see

N93-22081 08-16)
Avail: CASI HC A03/MF A04

N93-22096*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PROPULSION SYSTEMS PANEL
Carmelo J. Bianca, Robert Miner (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), Lawrence M. Johnston, R. Bruce (National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.), Daniel P. Dennies (Aerojet-General Corp., Sacramento, CA.), W. Dickenson (National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.), Robert Dreshfield (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), Walt Karakulko (Lockheed Engineering and Sciences Co., Houston, TX.), Mike McGaw (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), and Paul M. Munafo et al *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 210-256 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

N93-22101*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PROPULSION SYSTEMS PANEL DELIBERATIONS
Carmelo J. Bianca, Robert Miner (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), Lawrence M. Johnston, R. Bruce (National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.), Daniel P. Dennies (Aerojet-General Corp., Sacramento, CA.), W. Dickenson (National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.), Robert Dreshfield (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), Walt Karakulko (Lockheed Engineering and Sciences Co., Houston, TX.), Mike McGaw (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), and Paul M. Munafo et al *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 295-300 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

N93-22102*# United Technologies Corp., San Jose, CA. Chemical Systems Div.
HYBRID ROCKET PROPULSION
Allen L. Holzman *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 303-319 (For primary document see N93-22081 08-16)
Avail: CASI HC A03/MF A04

N93-22313*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THRUSTER CONFIGURATIONS FOR MANEUVERING HEAVY PAYLOADS Abstract Only
Roy K. Tsugawa (TRW, Inc., Redondo Beach, CA.), Michael E. Draznin (TRW, Inc., Redondo Beach, CA.), and Richard W. Dabney *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

23 CHEMISTRY AND MATERIALS (GENERAL)

N93-22586*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPTICAL AND SCRATCH RESISTANT PROPERTIES OF DIAMONDLIKE CARBON FILMS DEPOSITED WITH SINGLE AND DUAL ION BEAMS
Michael T. Kussmaul (Sverdrup Technology, Inc., Brook Park, OH.), Michael S. Bogdanski (Case Western Reserve Univ., Cleveland, OH.), Bruce A. Banks, and Michael J. Mirtich Jan. 1993 11 p Presented at the Technology 2002 Conference, Baltimore, MD, 1-3 Dec. 1992; sponsored by Technology Utilization
(RTOP 141-20-OJ)
(NASA-TM-105943; E-7571; NAS 1.15:105943) Avail: CASI HC A03/MF A01

Amorphous diamondlike carbon (DLC) films were deposited using both single and dual ion beam techniques utilizing filament and hollow cathode ion sources. Continuous DLC films up to 3000 A thick were deposited on fused quartz plates. Ion beam process parameters were varied in an effort to create hard, clear films. Total DLC film absorption over visible wavelengths was obtained using a Perkin-Elmer spectrophotometer. An ellipsometer, with an Ar-He laser (wavelength 6328 A) was used to determine index of refraction for the DLC films. Scratch resistance and frictional and adherence properties were determined for select films. Applications for these films range from military to the ophthalmic industries. Author

N93-22590*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SLIDING DURABILITY OF CANDIDATE SEAL FIBER MATERIALS IN HYDROGEN FROM 25 TO 900 C
Christopher DellaCorte and Bruce M. Steinetz 1992 18 p Prepared for presentation at the 5th NASA/NASP Hydrogen-Material Interactions Workshop, Scottsdale, AZ, 23-25 Sep. 1993
(RTOP 505-63-1A)
(NASA-TM-105939; E-7456; NAS 1.15:105939) Avail: CASI HC A03/MF A01

Sliding durability studies of candidate ceramic fibers were conducted in hydrogen to support the high temperature seal development program at NASA LeRC. Pin-on-disk tests were used to measure the friction and durability of a tow or bundle of ceramic fibers in sliding against a superalloy disk. This procedure was used previously to test candidate fibers in an air environment. The fibers based upon mullite (Al2O3-SiO2) chemistry (Nextel 550, 440, and 312) exhibited better durability in hydrogen than in air. HPZ, a complex silicon carboxynitride fiber which showed good durabilty in air, however, showed a significant loss of durability in hot hydrogen. These results are consistent with recent thermodynamic and experimental studies of ceramic compatibility with hydrogen at elevated temperatures. These research results indicate that only oxide fibers display good durability in both air and hydrogen environments. Also, simple, low cost testing in air can provide an adequate data base for initial seal material screening and selection, especially for oxide fiber candidates. The findings of this research provide critical input to the seal design team. Author (revised)

N93-22605*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DETERMINATION OF ATOMIC OXYGEN FLUENCE USING SPECTROPHOTOMETRIC ANALYSIS OF INFRARED TRANSPARENT WITNESS COUPONS FOR LONG DURATION EXPOSURE TESTS
Gregg M. Podojil (Cleveland State Univ., OH.) and Donald A. Jaworske Feb. 1993 14 p
(RTOP 506-41-41)
(NASA-TM-106021; E-7582; NAS 1.15:106021) Avail: CASI HC A03/MF A01

Atomic oxygen degradation is one of several major threats to the durability of spaceborne systems in low Earth orbit. Ground-based simulations are conducted to learn how to minimize the adverse effects of atomic oxygen exposure. Assessing the fluence of atomic oxygen in test chambers such as a plasma asher over long periods of time is necessary for accurate determination of atomic oxygen exposure. Currently, an atomic oxygen susceptible organic material such as Kapton is placed next to samples as a witness coupon and its mass loss is monitored and used to determine the effective atomic oxygen fluence. However, degradation of the Kapton witness coupons occurs so rapidly in plasma ashers that for any long term test many witness coupons must be used sequentially in order to keep track of the fluence. This necessitates opening vacuum to substitute fresh coupons. A passive dosimetry technique was sought to monitor atomic oxygen exposure over longer periods without the need to open the plasma asher to the atmosphere. This paper investigates the use of spectrophotometric analysis of durable IR transparent witness coupons to measure atomic oxygen exposure for longer duration testing. The method considered would be conductive to making in situ measurements of atomic oxygen fluence. Author

N93-23014*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

AN ALTERNATIVE MODEL FOR ESTIMATING LIQUID DIFFUSION COEFFICIENTS REQUIRING NO VISCOSITY DATA

Wilfredo Morales Mar. 1993 22 p

(RTOP 505-63-5A)

(NASA-TM-106079; E-7695; NAS 1.15:106079) Avail: CASI HC A03/MF A01

An equation, based on the free volume of a liquid solvent, was derived via dimensional analysis, to predict binary diffusion coefficients. The equation assumed that interaction between the solute and liquid solvent molecules followed a Lennard-Jones potential. The equation was compared to other diffusivity equations and was found to give good results over the temperature range examined. Author

N93-23077*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

POLYBENZOXAZOLES VIA AROMATIC NUCLEOPHILIC DISPLACEMENT Patent Application

Paul M. Hergenrother, inventor (to NASA), John W. Connell, inventor (to NASA), and Joseph G. Smith, Jr., inventor (to NASA) (Akron Univ., OH.) 10 Apr. 1992 20 p

(NASA-Case-LAR-14606-1-CU; NAS 1.71:LAR-14606-1-CU; US-Patent-Appl-SN-867864) Avail: CASI HC A03/MF A01

Polybenzoxazoles (PBO) are heterocyclic macromolecules which were first synthesized in a two-step process by the initial formation of aromatic diacid chlorides with bis(o-aminophenol)s through solution condensation of aromatic diacid chlorides with bis(o-aminophenol)s followed by thermal cyclodehydration. Since then several methods have been utilized in their synthesis. The most common synthetic method for PBO involves a polycondensation of bis(o-aminophenol)s with aromatic diacid diphenyl esters. Another preparative route involves the solution polycondensation of the hydrochloride salts of bis(o-amino phenol)s with aromatic diacids in polyphosphoric acid. Another synthetic method involves the initial formation of poly(o-hydroxy amide)s from silylated bis(o-aminophenol)s with aromatic diacid chlorides followed by thermal cyclodehydration to PBO. A recent preparative route involves the reaction of aromatic bisphenols with bis(fluorophenyl) benzoxazoles by the displacement reaction to form PBO. The novelty of the present invention is that high molecular weight PBO of new chemical structures are prepared that exhibit a favorable combination of physical and mechanical properties. NASA

N93-24288# National Research Council of Canada, Boucherville (Quebec). Industrial Materials Inst.

[ACTIVITIES OF THE INDUSTRIAL MATERIALS INSTITUTE] Annual Report, 1991-1992 [INSTITUT DES MATERIAUX INDUSTRIELS, RAPPORT ANNUEL 1991-1992]

1992 58 p In ENGLISH and FRENCH

(NRC-34380; IMI92D-00000-1382-G; CTN-93-60706) Copyright Avail: CASI HC A04/MF A01

The Industrial Materials Institute (IMI) of Canada's National Research Council has the mission to promote growth and competitiveness of Canadian industry through basic and applied research related to materials processing technologies. To carry out this mission, the IMI undertakes research and development projects in collaboration with industry on materials characterization and on the control, simulation, and perfection of process systems. It also promotes awareness of the latest in materials technology, supports improved utilization by demonstration projects and complementary activities, and provides coordination to all materials activities at the Council. There are currently 13 active research programs at the IMI in four sections: Instrumentation and Sensors, Metals and Ceramics, Industrial Polymers, and Computer Integrated Materials Processing. Research goals and major achievements in these programs are reviewed for 1991-1992. Lists of publications are also included. CISTI

N93-24412# Wisconsin Univ., Madison.

MOLECULAR PROPERTIES AND FATE OF ORGANIC CHEMICALS Final Report, 15 Aug. 1988 - 14 Aug. 1992

Anders W. Andren Sep. 1992 231 p

(Grant AF-AFOSR-0301-88)

(AD-A260090; AFOSR-92-1016TR) Avail: CASI HC A11/MF A03

Quantitative structure property relationships (QSPR's) utilizing total molecular surface area (TSA) are evaluated for predicting physical-chemical properties (aqueous solubility and saturation vapor pressure) used to determine environmental partitioning and transport of hydrophobic organic contaminants. The theoretical relationship between the physical-chemical properties and TSA is reexamined and, methods and parameters for calculating TSA were compared including: standard (planar) geometries and bond lengths versus energy minimized molecular coordinates, van der Waals versus contact/reentrant surface area, and van der Waals radii. Two assumptions for estimating the molar free energy of fusion are also evaluated. A strong, thermodynamically sound relationship between TSA and aqueous solubility allows for solubility predictions of aromatic chemicals from 5 C to 40 C with an average absolute error of 92 degrees. A weaker, empirical relationship between saturation vapor pressure and TSA yields vapor pressure estimates for organic contaminants with an average absolute error of 232 percent between 5 deg C and 40 deg C. The results indicate that the work of cavity formation in water and/or the work of adhesion between the solute and water is the dominant term in the dissolution process, and is adequately described via a TSA-QSPR. Conversely, the work required to remove a molecule from bulk liquid to vapor is loosely related to TSA. The predicted physical-chemical properties can be used to determine the air/water partition coefficients of organic contaminants at environmental temperatures. GRA

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials*.

N93-22066# Argonne National Lab., IL.

APPLICATION OF NEUTRON DIFFRACTION TECHNOLOGY TO THE DETERMINATION OF RESIDUAL STRAIN IN ENGINEERING COMPOSITES

D. S. Kupperman 1992 19 p Presented at the Winter Annual Meeting of the ASME, Anaheim, CA, 8-13 Nov. 1992

(Contract W-31-109-eng-38)

(DE93-004249; ANL/CP-77428; CONF-921110-37) Avail: CASI HC A03/MF A01

Knowledge of fabrication induced residual stresses in the fiber and matrix of advanced engineering composites is important as these stresses can greatly influence the mechanical properties of these composites. In this paper, the application of neutron diffraction technology to the determination of thermal residual strains in the constituents of composites (from which stresses can be calculated) is discussed. Experimental determination of temperature dependent strain in the fiber and matrix of three composites compare favorably with the results of analytical and finite element methods used to predict strain. These composites (two ceramic matrix and one metal matrix) are materials of interest to a variety of industries. In this paper, the benefit of applying a National Laboratory developed technology to a problem of interest to industry, is shown. DOE

N93-22410# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Mechanical Engineering.

THEORETICAL MODELS FOR THE ULTIMATE STRENGTH AND FLAW RESISTANCE OF UNIDIRECTIONALLY-REINFORCED CERAMIC-MATRIX COMPOSITES

P. S. Steif 1992 8 p

(Contract DE-FG02-89ER-45404)

(DE93-005881; DOE/ER-45404/3) Avail: CASI HC A02/MF A01

Progress is reported in the following areas: (1) interpretation of interface tests; (2) the effect of interface properties on flexural strength and its connection with uniaxial tensile strength; and (3) the effect of interface properties on uniaxial tensile strength. The goal is to establish relations between manipulable material variables and mechanical response. The approach was as follows: (1) to hypothesize as to the key underlying physical mechanisms and to represent these hypotheses with model theoretical problems which can relate material parameters to observed mechanical behavior; (2) to develop the necessary techniques to analyze the model problems; and (3) to test the models by comparing the obtained results with experimental data. Phases 1 and 2 were been brought to

satisfactory completion; work remains to be done on the third phase.
DOE

N93-22432# Los Alamos National Lab., NM.
STRAIN MEASUREMENT IN INDIVIDUAL PHASES OF AN Al/TiC COMPOSITE DURING MECHANICAL LOADING
M. A. M. Bourke, J. A. Goldstone, M. G. Stout, A. C. Lawson, and J. E. Allison 1992 12 p Presented at the Annual Meeting of The Metallurgical Society, Denver, CO, 21-25 Feb. 1993
(Contract W-7405-eng-36)
(DE93-003806; LA-UR-92-3596; CONF-930202-2) Avail: CASI HC A03/MF A01

Neutron diffraction provides a unique method for examining materials during thermomechanical loading because it is nondestructive and penetrating and can distinguish between the strains in individual phases. Using a pulsed neutron source, all lattice reflections are recorded in all constituents simultaneously. Preliminary in-situ strain measurements under load of an aluminum/titanium carbide composite are presented. The measurements were made using a compact stress rig on the neutron powder diffractometer at the Manuel Lujan Jr. Neutron Scattering Center at Los Alamos National Laboratory. DOE

N93-22504# Sandia National Labs., Albuquerque, NM.
SOL-GEL/RHODAMINE 6G COMPOSITE FILMS WITH TAILORED MICROSTRUCTURES
D. L. Logan, C. S. Ashley, R. A. Assink, and C. J. Brinker 1992 10 p Presented at the 2nd Sol-Gel Optics Conference, San Diego, CA, 19-24 Jul. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005364; SAND-92-0037C; CONF-9207172-1) Avail: CASI HC A02/MF A01

A multi-step hydrolysis procedure was developed to prepare composite organic dye/sol-gel thin films with variable porosity for such as switches or sensors. Variation of acid and base catalyzed hydrolysis sequences of three sols prepared from tetraethoxysilane with identical H2O/Si ratios, dilution factors, and pH resulted in considerably different silicate speciation. Under conditions where monomer was avoided, the refractive indices of as-deposited films could be varied by an again step prior to film deposition. This general strategy, which relies on the aggregation of fractal polymeric clusters, is compatible with the low temperature and near neutral pH requirements of both organic dyes and biologically active species such as enzymes. DOE

N93-22578# Oak Ridge National Lab., TN.
INFLUENCE OF FIBER COATINGS ON THE OXIDATION OF FIBER-REINFORCED SiC COMPOSITES
P. F. Tortorelli, L. Riester, R. A. Lowden, and S. Nijhawan (Coe Coll., Cedar Rapids, IA.) 1993 9 p Presented at the 17th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 11-15 Jan. 1993
(Contract DE-AC05-84OR-21400)
(DE93-006742; CONF-930164-4) Avail: CASI HC A02/MF A01

Thermogravimetric analysis was used to study the reaction kinetics associated with high-temperature air oxidation of graphite- or BN-coated Nicalon-reinforced SiC composites. For those with graphite interlayers, the shapes of the thermogravimetric curves, and the dependencies of weight changes on interfacial layer thickness and exposure temperature, could be explained on the basis of concurrent reactions associated with oxidation of the graphite and the formation of SiO2 on the matrix and fibers. The oxidation resistance of SiC with BN-coated Nicalon fibers was significantly better than when graphite coatings were used.. Flexure tests of Nicalon/graphite/SiC previously oxidized in air at 950 C revealed that degradation of fracture resistance can be detected after very short exposure times (less than 1 h). Accordingly, a knowledge of reaction kinetics is important in characterizing environmental effects on fracture and damage and in predicting the rate of properties degradation. DOE

N93-22591# Interior Dept., Washington, DC.
PRESSURE-REACTION SYNTHESIS OF TITANIUM COMPOSITE MATERIALS Patent Application
Laurance L. Oden, inventor (to Interior Dept.), Thomas L. Ochs, inventor (to Interior Dept.), and Paul C. Turner, inventor (to Interior Dept.) 31 Jul. 1992 16 p
(PB93-135036; US-Patent-Appl-SN-922412; Pat-Appl-7-922412) Avail: CASI HC A03/MF A01

The invention relates to a pressure-reaction synthesis (PRS) process for forming titanium metal matrix composites by controlled chemical reaction of a mixture of metal and nonmetal powders under specific conditions of temperature within a forming die under specific conditions of pressure.
Author

N93-22603# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
RESIN TRANSFER MOLDING: AN ANSWER TO THE PROBLEM OF THE INDUSTRIALIZATION OF COMPOSITES. APPLICATION TO NACELLES AND THRUST REVERSE PARTS [RESIN TRANSFER MOLDING: UNE REPONSE AU PROBLEME DE L'INDUSTRIALISATION DES COMPOSITES. UNE APPLICATION AUX PIECES DE NACELLES ET INVERSEURS DE POUSSEE]
H. Girardy, S. A. Brochier, and Didier Vigneron (Hispano-Suiza, Le Havre, France.) 1991 11 p In FRENCH Presented at AAAF 39th Salon International de Paris on Materiaux pour l'Aeronautique, Le Bourget, France, 14-23 Jun. 1991
(DS-2024; ETN-93-93395) Avail: CASI HC A03/MF A01

The application of the INJECTEX (trademark) procedure to the 1H/11H material of the CFM56-517 engine is reported. This procedure is based on Resin Transfer Modeling (RTM) technology which is used for the production of composite parts. RTM consists of injecting a resin into a mold containing reinforcing fibers. The differences between RTM and INJECTEX are outlined. The main difference being that INJECTEX involves the use of high performance technical fibers. The fibers and resins used in the INJECTEX procedure are described. The procedure is outlined giving details of the dry performing technology and the injection procedure. Results of tests of the mechanical properties of plates molded by the INJECTEX procedure are presented. The potential application to the following is considered: fittings in the interior of civil planes, exterior secondary parts, primary exterior parts, and engine parts. ESA

N93-22657# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Gruppe Zerstoerungsfrie Pruefung.
DEVELOPMENT AND PRODUCTION OF SANDWICH RODS WITH LOAD TRANSMITTING ELEMENTS CARRYING HIGH TENSION AND COMPRESSION LOADS [ENTWICKLUNG UND FERTIGUNG VON ZUG- UND DRUCKSTAEBEN AUS FASERVERBUNDWERKSTOFFEN MIT HOCHBELASTBAREN KRAFTEINLEITUNGEN]
Rainer Schuetze Aug. 1991 34 p In GERMAN
(DLR-FB-91-33; ETN-93-91923) Avail: CASI HC A03/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

It is shown that the structural weight of push rods used in commercial aircraft can be signficantly reduced by using Carbon Fiber Reinforced Plastics (CFRP) instead of aluminum. A simple substitution is not possible on account of the load transmission and the complex stress states generated by them. Besides stiffness and strength, the production costs are another important parameter. A form locking load transmission which can be adapted to standardized CFRP rods demonstrates how the properties of high strength and low structural weight can be combined with an economically advantageous wholescale production. ESA

N93-22815# Technical Research Centre of Finland, Espoo. Metals Lab.
INTERLAMINAR MODE-2 FRACTURE TOUGHNESS OF A GLASS-FIBER EPOXY LAMINATE
Heikki Keinanen, Tero Uuttu, and Mikko Lehtonen 1992 33 p Sponsored by Technical Research Centre of Finland
(VTT-Pubs-105; ISBN-951-38-4223-1; ETN-93-93543) Copyright Avail: CASI HC A03/MF A01

Fracture mechanics and experimental mechanics approaches were used to characterize mode 2 interlaminar fracture of a Glass Fiber Reinforced Epoxy (GRFP) laminate. Mode 2 interlaminar fracture toughness was characterized by using the End Notched Flexure (ENF) test. The ENF specimen was modeled by using both analytical (beam theory) and numerical (finite element method) approaches. Calculated results were compared to experimental ones and the interlaminar mode 2 fracture toughness of the

particular laminate was determined. In the particular case the ENF test is suitable for characterization of the interlaminar fracture toughness. ESA

N93-22875*# Textron Lycoming, Stratford, CT.
ADVANCED REINFORCEMENT SYSTEMS FOR INTERMETALLIC APPLICATIONS
Howard F. Merrick and Mohammed L. Labib Washington Mar. 1993 54 p
(Contract NAS3-25970; RTOP 510-01-50)
(NASA-CR-4488; E-7557; NAS 1.26:4488) Avail: CASI HC A04/MF A01

A 2-D axisymmetric model was employed to determine the magnitude of the radial, axial, and hoop stresses caused by the thermal expansion difference between fiber and matrix and which result from the fabrication temperature cycle. Finite element analysis was conducted for single fiber model systems based on SCS-6/Ti3Al+Nb and Al2O3/NiAl. The stress distribution due to the imposition of a graded intermediate layer for each system was determined and included variables of layer thickness and gradation in interlayer chemistry in order to vary the expansion gradient between fiber and matrix. Thermal cycling tests were conducted on sputter coated SCS-6 fibers selectively coated with Ti3Al+Nb, with and without an intermediate layer. Cracking of the Ti3Al+Nb layers was prevented by an interlayer based on Ti-TiN-Ti. The interlayer thickness appeared critical to its efficiency. Similarly, for the case of Al2O3/NiAl, an intermediate layer consisting of a Ni bond coat on the sapphire fiber followed by a graded Al2O3-NiAl layer did not crack when given a thermal excursion to 1100 C and then cooled to room temperature. Acoustic emission tests on single fiber specimens were unsuccessful in detecting load drops associated with the successive fracture of the fiber. For the SCS-6/Ti3Al system this was the result of several factors which included the matrix/fiber ratio and poor bonding of the matrix and fiber. In the case of the Al2O3/NiAl system brittle failure of the NiAl matrix precluded fiber breakdown during tensile loading. Author (revised)

N93-22911# Argonne National Lab., IL.
SOLID-PARTICLE EROSION OF IN-SITU REINFORCED Si3Ni4
M. Marrero, J. Routbort, P. Whalen (Allied-Signal Corp., Morristown, NJ.), Chien-Wei Li (Allied-Signal Corp., Morristown, NJ.), and K. R. Karasek (Allied-Signal Aerospace Co., Des Plaines, IL.) Apr. 1992 17 p Presented at the 9th International Conference of Wear of Materials, San Francisco, CA, 13-17 Apr. 1993
(Contract W-31-109-eng-38)
(DE92-014868; ANL/CP-75205; CONF-930414-1) Avail: CASI HC A03/MF A01

Steady-state solid-particle erosion has been investigated on in-situ reinforced Si3N4 and the 'equivalent' fine-grained hot-isostatically-pressed Si3N4 whose R-curve behaviors are quite different, having K(sub IC) values in the long-crack-limit of 8.3 and 5.6 MPa m(exp (1/2)), respectively. Experiments were carried out at 20 C, using SiC abrasives, whose diameters ranged from 42 to 1035 micron, varying the angle of impact from 15 to 90 degrees and the velocity from 50 to 100 to 150 m/s. The erosion rates of the two materials were, within a factor of two, the same, indicating that the long-crack-length-limit toughness is not an indication of erosion resistance, for the range of particle sizes and velocities studied. DOE

N93-22973# Ames Lab., IA.
ROLE OF INTERFACES ON THE DUCTILE FRACTURE PROCESS OF DISCONTINUOUS FIBER REINFORCED COMPOSITES
S. B. Biner 1992 7 p Presented at the International Conference on Advanced Composites 1993, Wollongoup, Australia, 15-19 Feb. 1993
(Contract W-7405-eng-82)
(DE93-004464; IS-M-736; CONF-930246-2) Avail: CASI HC A02/MF A01

The roles of fiber morphology, interface failure, and void nucleation mechanisms within the matrix on the deformation and fracture behavior of discontinuous fiber reinforced composites was numerically investigated. The matrix was modelled using a constitutive relationship that accounts for strength degradation resulting from the nucleation and growth of voids, and fibers are assumed to be elastic. The debonding behavior at the fiber interfaces was simulated in terms of a cohesive zone model which describes the decohesion by both normal and tangential separation. The results indicate that in the absence of interface failure, for a given matrix failure mechanism, the fiber morphology strongly affects the strength and ductility of discontinuous fiber reinforced composites. The weak interfacial behavior can significantly increase the ductility without sacrificing the strength for certain fiber morphology and for certain void nucleation mechanisms. DOE

N93-23043*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
COMPRESSION STRENGTH FAILURE MECHANISMS IN UNIDIRECTIONAL COMPOSITE LAMINATES CONTAINING A HOLE Final Report, 1 Jun. 1981 - 1 Jun. 1989
Eric R. Johnson Apr. 1993 16 p
(Grant NAG1-201)
(NASA-CR-192813; NAS 1.26:192813) Avail: CASI HC A03/MF A01

Experiments on graphite-epoxy laminated plates containing unloaded small holes show that these laminates are notch insensitive. That is, the uniaxial strength of these laminates with small holes exceeds the strength predicted by a point stress criterion using the stress concentration factor for the in-plane stress field. Laminates containing large holes exhibit notch sensitive behavior and consequently their strength is reasonably well predicted by the stress concentration effect. This hole size effect is manifested both in tension and in compression. Apparently, some mechanism must cause in-plane stress relief for laminates containing small holes. The purpose of this research was to study the influence of geometric nonlinearity on the micromechanical response of a filamentary composite material in the presence of a strain gradient caused by a discontinuity such as a hole. A mathematical model was developed at the micromechanical level to investigate this geometrically nonlinear effect. Author

N93-23073*# Georgia Inst. of Tech., Atlanta.
ANALYSIS OF DELAMINATION RELATED FRACTURE PROCESSES IN COMPOSITES Final Technical Report, Feb. 1986 - Dec. 1992
Erian A. Armanios Dec. 1992 155 p
(Grant NAG1-637)
(NASA-CR-192632; NAS 1.26:192632) Avail: CASI HC A08/MF A02

This is a final report that summarizes the results achieved under this grant. The first major accomplishment is the development of the sublaminate modeling approach and shear deformation theory. The sublaminate approach allows the flexibility of considering one ply or groups of plies as a single laminated unit with effective properties. This approach is valid when the characteristic length of the response is small compared to the sublaminate thickness. The sublaminate approach was validated comparing its predictions with a finite element solution. A shear deformation theory represents an optimum compromise between accuracy and computational effort in delamination analysis of laminated composites. This conclusion was reached by applying several theories with increasing level of complexity to the prediction of interlaminar stresses and strain energy release rate in a double cracked-lap-shear configuration. Author

N93-23113# Institute for Aerospace Research, Ottawa (Ontario). Structures and Materials Lab.
LOCALIZED DAMAGE DEVELOPMENT IN NOTCHED COMPOSITE PLATES SUBJECTED TO COMPRESSIVE LOADING
C. J. Poon, N. C. Bellinger, and R. W. Gould Jul. 1992 22 p
(CTN-93-60663) Avail: CASI HC A03

The mechanism of localized damage development in notched plates made of graphite/epoxy composite under compressive loading was investigated. Flat composite plates with an open hole in the center were loaded in compression and damage development at the hole edge was determined by the ultrasonic C-scan method and penetrant enhanced x-ray radiography. It was observed that the initial damage development occurs at about 90 percent of the ultimate load. This initial damage consists of localized delamination, ply buckling, and fiber fracture at the edge of the hole. A further increase in load level triggers rapid damage progression from the hole edge to the longitudinal edges of the plate. A 3-dimensional finite element analysis was performed to determine the interlaminar stresses at the hole edge. When these interlaminar stresses were used in conjunction with a proposed failure criterion, the strain level at which damage initiated was predicted. The predictive results demonstrate good agreement with experimental data. Author (CISTI)

N93-23202 Cornell Univ., Ithaca, NY.
THE EFFECTS OF DELAMINATION ON THE VIBRATIONAL CHARACTERISTICS OF COMPOSITE STRUCTURAL ELEMENTS Ph.D. Thesis
Kenneth Bhalla 1992 214 p
Avail: Univ. Microfilms Order No. DA9236005

The frequencies of vibration and mode shapes of delaminated beams and annular plates are studied to determine whether the change in frequency response or mode shape is a satisfactory criterion for determining the existence, location, and size of defects in laminated composite materials. Composites beams and plates composed of two laminae having a 1:1 and 2:1 thickness ratio were considered. A quantitative relationship between delamination length and frequency response was found. This relationship was determined through a consideration of the governing differential equations, by finite element analysis, and through experimental evaluation. The results are presented as a series of graphs, showing the change in the first three natural frequencies as a function of delamination length together with the variation of the tip displacement of a cantilevered beam for a constant energy input. The influence of the delamination on the frequency was noticeable in higher modes than lower. Dissert. Abstr.

N93-23246# Los Alamos National Lab., NM.
THE MECHANICAL PROPERTIES OF A NOVEL Si3N4-AMORPHOUS Si3N4 COMPOSITE
I. E. Reimanis, J. J. Petrovic, H. Suematsu, T. E. Mitchell, and O. S. Leung 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-7405-eng-36)
(DE93-005473; LA-UR-92-4276; CONF-921101-55) Avail: CASI HC A02/MF A01

The hardness and fracture toughness of a model two-phase composite consisting of crystalline Si3N4 particles in a matrix of amorphous Si3N4 are examined. The composite is created by beat treating high purity, partially amorphous CVD Si3N4 in N2 for various times and temperatures in order to induce crystallization of the alpha phase. Microindentation tests at temperatures up to 1200 C are conducted to evaluate the high-temperature hardness and fracture toughness. The role of the microstructure is examined using optical and transmission electron microscopy. Finally, the relation between microstructure and the mechanical properties is discussed. DOE

N93-23311# Oak Ridge National Lab., TN.
EVALUATION OF TENSILE STATIC, DYNAMIC, AND CYCLIC FATIGUE BEHAVIOR FOR A HIPed SILICON NITRIDE AT ELEVATED TEMPERATURES
Chih-Kuang Jack Lin (Oak Ridge Inst. of Nuclear Studies, Inc., TN.), M. G. Jenkins, and M. K. Ferber 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005149; CONF-921101-27) Avail: CASI HC A02/MF A01

Tensile fatigue behavior of a hot-isostatically-pressed (HIPed) silicon nitride was investigated over ranges of constant stresses, constant stressing rates, and cyclic loading at 1150-1370 C. At 1150 C, static and dynamic fatigue failures were governed by slow crack growth mechanism. Creep rupture was the dominant failure mechanism in static fatigue at 1260 and 1370 C. A transition of failure mechanism from slow crack growth to creep rupture appeared at stressing rates less than or equal to 10(exp -2) MPa/s for dynamic fatigue at 1260 and 1370 C. At 1150-1370 C, cyclic loading appeared to be less damaging than static loading as cyclic fatigue specimens last longer than static fatigue specimens under the same maximum stresses. DOE

N93-23400# Construcciones Aeronauticas S.A., Madrid (Spain).
GEL TIME MEASUREMENTS ON CARBON FIBER/EPOXY RESIN PREPREGS
J. P. Alary, S. Lazcano, A. Sanchez, A. T. Rodriguez, and J. Sanchez 1990 8 p
(ICAS-90-4-10-4; ETN-93-93697) Avail: CASI HC A02/MF A01

The curing process of a modified epoxy resin/carbon fiber prepreg, Hercules 8552/AS4, was analyzed by means of Differential Scanning Calorimetry (DSC) and Rheometrics Dynamic Spectrometer (RDS). Isothermal and nonisothermal experiments were carried out, and similar studies were performed in the near resin Hercules 8552. DSC and RDS data were compared with the main goal of establishing a correlation between the gel time determined by both means, together with the ones measured in a Fisher-Johns apparatus. A simple criterion for obtaining the gel point by DSC measurements was found. Comparison between the three tests showed good agreement for the calculated gel times. The activation energies of the gelification process were calculated and similar values were obtained for the three data series. ESA

N93-23429*# Ohio Aerospace Inst., Brook Park.
INTEGRATED ANALYSIS AND DESIGN OF THICK COMPOSITE STRUCTURES FOR OPTIMAL PASSIVE DAMPING CHARACTERISTICS Final Report
D. A. Saravanos Mar. 1993 69 p
(Contract NCC3-208/4; RTOP 505-63-5B)
(NASA-CR-190783; E-7676; NAS 1.26:190783) Avail: CASI HC A04/MF A01

The development of novel composite mechanics for the analysis of damping in composite laminates and structures and the more significant results of this effort are summarized. Laminate mechanics based on piecewise continuous in-plane displacement fields are described that can represent both intralaminar stresses and interlaminar shear stresses and the associated effects on the stiffness and damping characteristics of a composite laminate. Among other features, the mechanics can accurately model the static and damped dynamic response of either thin or thick composite laminates, as well as, specialty laminates with embedded compliant damping layers. The discrete laminate damping theory is further incorporated into structural analysis methods. In this context, an exact semi-analytical method for the simulation of the damped dynamic response of composite plates was developed. A finite element based method and a specialty four-node plate element were also developed for the analysis of composite structures of variable shape and boundary conditions. Numerous evaluations and applications demonstrate the quality and superiority of the mechanics in predicting the damped dynamic characteristics of composite structures. Finally, additional development was focused on the development of optimal tailoring methods for the design of thick composite structures based on the developed analytical capability. Applications on composite plates illustrated the influence of composite mechanics in the optimal design of composites and the potential for significant deviations in the resultant designs when more simplified (classical) laminate theories are used.
Author (revised)

N93-23703# Southwest Research Inst., San Antonio, TX.
CHARACTERIZATION OF MECHANICAL DAMAGE MECHANISMS IN CERAMIC AND POLYMERIC MATRIX COMPOSITE MATERIALS Technical Report, Oct. 1991 - Oct. 1992
James Lankford, Jr. Dec. 1992 79 p
(Contract N00014-92-C-0093)
(AD-A260129; Rept-06-5035) Avail: CASI HC A05/MF A01

In order to better establish the fundamental mechanisms responsible for the onset of microstructural instability during compressive loading, several fiber-reinforced polymeric matrix composites were tested under conditions involving hydrostatic confinement. It was found that the dependence of strength upon pressure was mild, indicating that the overwhelming factor in the compressive failure of these materials, irrespective of fiber type, matrix, composition, and composite architecture is resistance to shear loading; dilatational mechanisms, certainly ones associated with microfracture, are relatively insignificant. Specific strength levels do appear to be controlled by both inelastic and plastic flow properties of the matrix, and reflect the degree to which the matrix can restrain either the flexure of locally misaligned fibers, or the shear displacement of non-axial cross-plied fibers in more complex composite lay-ups. GRA

N93-23719 Cornell Univ., Ithaca, NY.
THE DIFFUSION OF LEAD TOWARD THE INTERFACE OF A RAPIDLY SOLIDIFIED CARBON FIBER REINFORCED ALUMINUM-LEAD MATRIX COMPOSITE Ph.D. Thesis
Eric Roger Murray 1992 299 p
Avail: Univ. Microfilms Order No. DA9300785

The controlled precipitation of lead from a supersaturated aluminum-lead alloy was investigated as a means of controlling interface properties in

aluminum/carbon fiber metal matrix composite. To this end, carbon fiber reinforced aluminum-lead metal matrix composites were produced using three techniques, namely, hot pressing (diffusion bonding), single-roller rapid solidification processing, and double-roller rapid solidification processing. Composites formed by hot pressing fibers between strips of rapidly solidified aluminum-lead ribbon showed lead precipitation at the fiber/matrix interface when examined in cross-section with energy Dispersive X-ray Spectroscopy. Single-roller rapid solidification of composites was carried out by attaching fibers to a single rotating chill surface upon which a molten aluminum-lead solution would be ejected. Such rapidly solidified composite ribbons contained only a very few fibers, due to poor wetting of the fibers by the melt. Wavelength Dispersive X-ray Spectroscopy showed that the precipitation of lead was suppressed. Subsequent thermal annealing could, however, initiate precipitation. To increase the volume fraction of fibers, an apparatus with two contacting chill surfaces was constructed. Composites produced with it included more fibers than those produced with the single-surface apparatus, while still suppressing the precipitation of lead. Thermal processing of these composites was investigated as a means of increasing the amount of lead at the fiber/matrix interface in a controlled manner. The lead concentration at the interface was found to increase, but the increase did not continue with further thermal processing. Indentation tests on composite cross-sections showed some improvement in the fiber/matrix bond as a result of this thermal processing, compared to the composite as prepared. Dissolution of the matrix material showed that the lead coating on the fiber is not uniform. Modeling of precipitation using a numerical solution of Ham's diffusion theory was carried out. It showed that if lead precipitation at the fiber/matrix interface was fed by migration of lead toward the fiber, then the region from which the lead was drawn must be small, much less than 75 microns in radius. Dissert. Abstr.

N93-23877*# Lockheed Engineering and Sciences Co., Hampton, VA.
APPROXIMATING THE STRESS FIELD WITHIN THE UNIT CELL OF A FABRIC REINFORCED COMPOSITE USING REPLACEMENT ELEMENTS
Final Report
R. L. Foye Feb. 1993 134 p
(Contract NAS1-19000; RTOP 505-63-50-04)
(NASA-CR-191422; NAS 1.26:191422) Avail: CASI HC A07/MF A02

This report concerns the prediction of the elastic moduli and the internal stresses within the unit cell of a fabric reinforced composite. In the proposed analysis no restrictions or assumptions are necessary concerning yarn or tow cross-sectional shapes or paths through the unit cell but the unit cell itself must be a right hexagonal parallelepiped. All the unit cell dimensions are assumed to be small with respect to the thickness of the composite structure that it models. The finite element analysis of a unit cell is usually complicated by the mesh generation problems and the non-standard, adjacent-cell boundary conditions. This analysis avoids these problems through the use of preprogrammed boundary conditions and replacement materials (or elements). With replacement elements it is not necessary to match all the constitutional material interfaces with finite element boundaries. Simple brick-shaped elements can be used to model the unit cell structure. The analysis predicts the elastic constants and the average stresses within each constituent material of each brick element. The application and results of this analysis are demonstrated through several example problems which include a number of composite microstructures. Author

N93-23935 National Research Council of Canada, Ottawa (Ontario).
AIRFRAME MATERIALS
Richard T. Holt, ed. and Stephen Lee, ed. Jul. 1991 176 p Presented at the 30th Annual CIM Conference of Metallurgists, Ottawa, Ontario, 21 Aug. 1991
(ISBN-0-919086-32-2; CTN-93-60642) Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

A symposium on airframe materials focused on the joining and bonding of airframe materials and the manufacturing, testing, and process modelling of composite materials for aerospace applications. Papers were presented on aluminum alloys and laminates, impact tests, failure predictions for adhesively bonded polymeric composites, joint failures resulting in aircraft accidents, composite structure manufacturing, consolidation of high performance thermoplastic tape, impact properties of composite materials, materials testing programs, and process modelling of filament winding. Separate abstracts have been prepared for 13 papers from this symposium. For individual titles, see N93-23936 through N93-23948.

N93-23936 Martin Marietta Corp., Baltimore, MD.
DESIGN OF AN ULTRA-HIGH-STRENGTH WELDABLE Al-Cu-Li ALLOY FOR SPACE APPLICATIONS **c26**
J. R. Pickens, F. H. Heubaum, and T. J. Langan *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 3-25 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

The alloy design considerations for an alloy intended for space launch systems are discussed in detail. Such an alloy requires a variety of properties such as good weldability, high strength and toughness at ambient and cryogenic temperatures, low density, and for certain applications, a strong natural aging response. An ultra high strength Al-Cu-Li space alloy has been designed which has met or exceeded its design goals, exceeding over 700 megapascals tensile strength in artificially aged conditions, 590 megapascals tensile strength in naturally aged conditions without cold work, high strength at 77 K, and 340 megapascals fusion weldment strength at room temperature. Alloying additions of Ag + Mg were successful in stimulating precipitation at several tempers. The properties of the early extrusions of the alloy are presented which display excellent reproducibility, a quality critical for successful alloy development. In addition, a refinement in composition (decreasing Cu content) to improve toughness without impairing weldability is introduced. The alloy is being commercialized under the trade name Weldalite 049, and has been registered in two variants, X2094 and X2095. Author (CISTI)

N93-23937 Aluminum Co. of America, Alcoa Center, PA.
INVESTIGATION OF GAS METAL ARC WELDING CHARACTERISTICS OF ALLOY 6013 **c26**
Frank G. Armao *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 27-42 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

An investigation was conducted to study the effects of gas metal-arc welding properties of plate and extrusions of alloy 6013, an aluminum alloy with 1 percent Cu that develops high strength and excellent toughness. Mechanical and corrosion properties of the gas metal-arc welds were determined and compared to those of welds made with alloy 6061, another aluminum alloy commonly used in welded fabrications. A comparison of tensile, yield, and elongation properties showed the as-welded tensile strength of 6013 welded with 4043 filler to be 35 megapascals higher than 6061 and yield strength 28 megapascals higher. Elongations were approximately the same, 7 percent. Weld properties of re-solution heat treated and aged 6013 were almost restored to the original tensile and yield strengths and elongation of the base materials. Corrosion resistance test results indicate base material and welds in 6013 to be similar in behavior to 6061. Author (CISTI)

N93-23938 Structural Laminates Co., Alcoa Center, PA.
FIBER-METAL LAMINATES: A SOLUTION TO WEIGHT, STRENGTH, AND FATIGUE PROBLEMS
Michael A. Gregory and Gerardus Hubertus Jo Roebroeks (Technische Univ., Delft, Netherlands.) *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 43-56 (For primary document see N93-23935 08-24)
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Fiber metal laminates offer a combination of improved strength and fatigue properties together with reduced density, indicating good potential for application in the aerospace industry. These laminates are a hybrid material composed of alternating layers of high-strength aluminum alloy sheet and fiber reinforced epoxy adhesive. During manufacture, the properties of these materials can be modified by varying fiber-resin systems, aluminum alloy and sheet gauge, stacking sequence, fiber orientation, surface

preparation techniques, and degree of post stretching. The characteristics of two series of fiber metal laminates are presented: ARALL aramid fiber-metal laminates which are unidirectionally reinforced for use in applications where the stress field is primarily unidirectional; and GLARE glass fiber-metal laminates, available in unidirectional or cross-ply configurations. Residual strength, durability, impact strength, and workshop properties are described. The main advantage of these laminates is their ability to impede and self-arrest crack growth, in contrast to monolithic aluminum sheet. In addition, significant weight savings can be obtained when substituting the laminates for aluminum sheet in such applications as fuselage skin, cargo doors, and wing components. Author (CISTI)

N93-23939 Institute for Aerospace Research, Ottawa (Ontario). Structures and Materials Lab.

A NEW METHOD OF IMPACT TENSION TESTING OF ADHESIVELY-BONDED JOINTS **c39**

C. Poon, B. Farahbaksh (Alcan International Ltd., Kingston, Ontario.), and M. Heinze (Alcan Deutschland G.m.b.H., Goetingen, Germany.) *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 57-74 (For primary document see N93-23935 08-24)

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An experimental methodology is described for determining the impact resistance of adhesively bonded lap joints in tension. The test configuration is versatile and reduces many of the inaccuracies associated with transient impact load measurements. It allows easy assembly of various joint configurations, especially those with thick adherents. The test apparatus is a modified version of an existing drop-weight impact machine, having a specially designed rig to hold a single lap joint specimen. The apparatus is provided with a high-speed data acquisition system for obtaining a complete load-time history experienced by the specimen to the point of failure. Results are presented for tests conducted on adhesively bonded aluminum alloy specimens. A load-time curve was obtained which provided circumstantial support for a cohesive failure mechanism, substantiated by results of an extensive post-fracture examination. Author (CISTI)

N93-23940 Toronto Univ. (Ontario). Dept. of Mechanical Engineering.

A FRACTURE MECHANICS APPROACH TO FAILURE LOAD PREDICTIONS OF STRUCTURAL ADHESIVE JOINTS

G. Fernlund and J. K. Spelt *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 75-86 (For primary document see N93-23935 08-24)

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An analytical approach is presented for the calculation of the energy release rate and its mode components for an arbitrarily loaded planar adhesive joint. By using the path indepedendent J-integral, the energy release rate and its mode components are expressed in terms of adherend reactions so that in many cases no explicit knowledge of the adhesive stresses is required. Experiments were conducted with cracked lap shear joint specimens of different adherend thicknesses subjected to a variety of loading conditions. The data showed that crack propagation in precracked specimens occurred at a critical energy release rate as calculated by the developed formulas, for a given mode ratio and bondline thickness. The data also showed that by treating uncracked specimens as being cracked, where a fictitious crack tip is assumed to coincide with the location of the fillet, a conservative estimate of the failure load is obtained. Author (CISTI)

N93-23941 Transportation Safety Board of Canada, Ottawa (Ontario).

THE CONSEQUENCE OF JOINT FAILURES

J. W. Hutchinson and D. C. Rocheleau *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 87-98 (For primary document see N93-23935 08-24)

Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

Three case studies are presented which address the use of mechanical fasteners, adhesive bonding, and welding to form joints in aircraft materials and components. The cases demonstrate the severe consequences of a joint failure and how prevention might have been achieved through better quality control. The first case involved a Piper Aircraft crash following an engine power loss caused by a blocked air flow to the engine. The carburetor air valve had detached from the actuator shaft due to wear and failure of rivets attaching the valve to the shaft. In the second case, a Bell Helicopter lost control on liftoff due to separation of a tail rotor drive shaft from its coupling adapter. The separation was attributed to in-flight debonding of adhesive holding the shaft components together. The third case involved failure of the main rotor transmission output shaft in a Hughes Helicopter. The failure was attributed to fatigue in the upper disc of the shaft due to the presence of a metallurgical stress concentration caused by electron weld beam impingement on the inner surface of the disc. Author (CISTI)

N93-23942 Ottawa Univ. (Ontario). Dept. of Mechanical Engineering.

AUTOMATED MANUFACTURING OF CONTINUOUS FIBRE COMPOSITE STRUCTURES FOR AEROSPACE APPLICATIONS Abstract Only

M. Munro, A. Fahim, E. Bernard, and M. Tenace *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 101 (For primary document see N93-23935 08-24)

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One of the major present challenges for composite materials is the development of manufacturing technology in which composite structures can be reliably mass produced at reasonable cost. Many existing processes are labor intensive, where the quality of the part depends partly on the skill of the craftsman. In this presentation, applications of automated manufacturing processes for continuous fiber composite structures (robotic and conventional filament winding, triaxial and three dimensional braiding, tape placement, pultrusion, and hybrid processes) are described. The important manufacturing parameters, critical issues, and future trends for selected processes are discussed. Author (CISTI)

N93-23943 Institute for Aerospace Research, Ottawa (Ontario). Structures and Materials Lab.

A REVIEW OF DESIGN AND MANUFACTURING METHODOLOGIES FOR STIFFENED COMPOSITE PANELS USED IN AIRCRAFT **c05**

F. Elaldi, S. Lee, and R. F. Scott *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 103-125 (For primary document see N93-23935 08-24)

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Stiffened panels used in aircraft structures typically consist of sheets having stiffeners attached and are designed to provide additional stiffness in the direction of primary loading. Lower weight and improved performance of such panels may be achieved by using composite materials in their construction. Design concepts for such panels are discussed, including buckle resistant and post-buckled designs, stiffener configuration, and stiffener-skin attachment design. Design parameters relevant to aircraft structures are evaluated, including load conditions, design of laminate (number of plies and their orientation), spacing between stiffeners, and allowable strain. Eleven computer codes that can be used in the design and analysis of composite stiffened panels are reviewed. For manufacturing these panels, tooling and fabrication are considered to be critical. Current manufacturing approaches focus on cocuring, where the skin and the siffener are cured together in a single autoclave cure, and secondary bonding, where stiffener and skin are cured separately then bonded together. In a review of these approaches, only compression and shear loadings are addressed since they are considered to be the most critical. Author (CISTI)

N93-23944 Institute for Aerospace Research, Ottawa (Ontario). Structures and Materials Lab.

EXPERIMENTAL INVESTIGATION OF CONSOLIDATION OF THERMOPLASTIC TAPE USING LASER ENERGY

S. Lee, S. Beland, and R. Hsu (Algonquin Coll., Ottawa, Ontario.) *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 127-148 (For primary document see N93-23935 08-24)

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Preliminary results are presented from an experimental investigation of the consolidation of carbon fiber reinforced polyether etherketone tape. Energy from a stationary CO2 laser was used as the focused heat source to melt the matrix material for subsequent consolidation. Processing parameters such as scanning width, frequency and power of the laser pulses, and the travelling speed of the tape were investigated. Qualitative evaluation of the degree of consolidation was conducted by examining cross sectional micrographs. Results indicate that the tape could be successfully consolidated under certain processing conditions. Laser power of 60, 70, and 80 watts combined with respective consolidation speeds of 2.5, 3.4, and 4.2 cm/s produced the best results. Author (CISTI)

N93-23945 Aeronautical Research Labs., Taichung (Taiwan).
THE CHARACTERIZATION OF IMPACT PROPERTIES OF COMPOSITES Abstract Only **c39**
K. H. Tu and C. L. Ong *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 149 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

Thermosetting and thermoplastic composites were impacted by an instrumented drop weight tester. X-ray analysis was used to measure the damage size and microscopic cross section observations were made to analyze the failure mechanism. Compression after impact tests were conducted to assess the residual properties (damage tolerance). Results have shown that thermoplastic composites AS4/APC-2 and IM7/APC-2 possess good damage tolerance, and IM7/APC-2, IM7/986, and T800/5250-3 have good impact resistance characteristics. In general, the toughness of the resin dominates the damage tolerance of the composite, and the impact resistance characteristic is controlled by the resin and the fiber. Author (CISTI)

N93-23946 Department of National Defence, Ottawa (Ontario). Polymeric Materials and Textiles Lab.
AN OVERVIEW OF MATERIALS TESTING IN DND Abstract Only **c27**
A. Savard, B. Guilmette, and S. Lee *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 151 (For primary document see N93-23935 08-24)
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The Quality Engineering Test Establishment (QETE) of Canada's Department of National Defence (DND) has the mandate to provide 4th line quality engineering and consultational services, including material failure investigations, product qualification, evaluation of new products and services, and reference laboratory services to the DND. Due to the increased use of composite materials in the Canadian Forces, the QETE's Polymeric Materials Laboratory is facing an evolving requirement to provide chemical expertise in this field. A review is provided of materials testing at this laboratory, along with examples of past and current work. Author (CISTI)

N93-23947 Stanford Univ., CA. Structures and Composites Lab.
DAMAGE IN LAMINATED COMPOSITES DUE TO LOW VELOCITY IMPACT Abstract Only **c39**
F. K. Chang *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 153 (For primary document see N93-23935 08-24)
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Both analytical and experimental work was performed to investigate the damage in laminated composites due to low velocity impact. A model has been developed for predicting the initial damage and the extent of multiple delaminations in composites due to impact. Experiments were also conducted on T300/976 composites. The results of embedded impact damage in composites were examined by X-ray and C-Scan machines. Numerical calculations based on the model were performed to simulate the test conditions. Overall, the predictions were fairly consistent with the test results. Author (CISTI)

N93-23948 Edo Corp. Ltd., Calgary (Alberta).
A PROCESS MODEL FOR CONTROL OF RESIN VOLUME FRACTION IN FILAMENT WOUND COMPOSITE LAMINATES
B. Hlavacek, S. N. Sirosh, and S. L. McKay *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 155-167 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

A process model has been developed to predict the amount of resin carried by a fiber in wet filament winding applications. The model is based on incorporating the surface tension effect into the Navier-Stokes equilibrium equation to predict the thickness of film that remains on the surface of a solid withdrawn from a quiescent liquid. From the resulting partial differential equations, expressions defining the thickness of liquid film adhering to the fiber and in turn the resin to fiber volume ratio are derived. The process model enables optimization of the winding speed and resin viscosity to achieve the required fiber volume fraction. Optimal resin content is important for high specific strength and stiffness, long fatigue life, and low environmental degradation. The wetting theory is examined along with its correspondence to experimental data. The relevance of the process model results to practical applications is discussed. The derived relationships suggest that for typical filament winding resins, a transition from resin transport through a wetting hydrodynamic process to a predominantly dragging process occurs during the fiber velocity interval from 0.04 to 0.4 m/s. Author (CISTI)

N93-23953# Boeing Defense and Space Group, Seattle, WA.
X-RAY COMPUTED TOMOGRAPHY FOR ADVANCED MATERIALS AND PROCESSES Interim Report, Aug. 1990 - May 1991
Gary Georgeson and Richard Bossi 30 Jun. 1992 56 p
(Contract F33615-88-C-5404)
(AD-A259828; WL-TR-91-4101) Avail: CASI HC A04/MF A01

Due to demanding requirements imposed on current and future high-performance aerospace structures, advanced materials are being developed for and used in a variety of aircraft/aerospace applications. Production costs for advanced materials are generally higher and the payback will be greater for data leading to faster decision making or improvement in the product. The development and qualification of new materials and joining and manufacturing processes for advanced aircraft/aerospace applications is accelerated by the availability of quantifiable data on design characteristics and their variations. X-ray computed tomography (CT) provides quantitative measurements of material characteristics in terms of the dimensions, density, and composition. The sensitivity of CT is dependent upon a number of factors including the test article and the CT system technology employed. The evaluation capability of CT overcomes the limitation of current qualitative inspection techniques to provide an objective measure of material or component condition. The results of studies involving CT testing of various advanced materials, manufacturing processes, and joining methods revealed four specific areas in which there is potential for significant economic benefit from CT. These areas are new product development, process control, noninvasive micrography, and material performance prediction. GRA

N93-24016# Xform, Inc., Cohoes, NY.
RESULTS ON POWDER INJECTION MOLDING OF Ni3Al AND APPLICATION TO OTHER INTERMETALLIC COMPOSITIONS
R. M. Cooper 1992 6 p Presented at the 16th Materials Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-FG01-91CE-15492)
(DE93-005681; CONF-921101-35) Avail: CASI HC A02/MF A01

Net forming processes are under development to allow affordable production of intermetallic components. Powder injection molding (PIM) mav be employed for the production of complex-shaped intermetallic geometries. Proper choice of powder parameters and processing conditions can lead to the formation of fully dense structures through pressure-less sintering. In this study, Ni3Al with 0.04 wt.-percent boron has been successfully injection molded and sintered to full density. A yield strength of 340 MPa, ultimate tensile strength (UTS) of 591 MPa, and 8 percent elongation were attained for injection molded and sintered tensile bars. Powder characteristics and sintering behavior are given for the nickel

aluminide employed in this study to highlight the powder attributes needed for injection molding. Molding parameters, debinding and sintering schedules, along with mechanical properties are presented to indicate the viability of PIM for intermetallics. This approach based on the understanding of key powder characteristics and use of the reactive synthesis powder process may be extended to the successful injection molding of other intermetallic systems. DOE

N93-24030# Argonne National Lab., IL. Materials and Components Technology Div.

EFFECT OF HIGH-TEMPERATURE LOADING ON MECHANICAL PROPERTIES OF NICALON FIBERS AND NICALON FIBER/SiC MATRIX COMPOSITES

D. Singh and J. P. Singh Jan. 1993 21 p Presented at the 17th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 11-15 Jan. 1993

(Contract W-31-109-eng-38)

(DE93-006420; ANL/MCT/CP-76993; CONF-930164-3) Avail: CASI HC A03/MF A01

Results of an investigation into the effect of elevated temperature exposure on the strength distribution of Nicalon fibers as well on mechanical properties of Nicalon/SiC composites are reported in this paper. Single-fiber strength distribution of as-fabricated Nicalon fibers was obtained from bundle tests. Strength distributions of fractured fibers in as-fabricated Nicalon/SiC composites and after elevated temperature exposure of composites were assessed from measurements of fracture mirror radii. Variations in the mechanical properties of composites evaluated as a function of test temperatures are compared with those evaluated at room temperature and are correlated to the fiber strength characteristics. Limited tests were also conducted to investigate the effect of long term exposure at elevated temperatures on composite ultimate strength. DOE

N93-24047# Ames Lab., IA.

HIGH TEMPERATURE DEFORMATION CHARACTERISTICS OF DISCONTINUOUS FIBER REINFORCED COMPOSITES

S. B. Biner 1992 7 p Presented at the International Conference on Advanced Composites 1993, Wollongoup, Australia, 15-19 Feb. 1993

(Contract W-7405-eng-82)

(DE93-004466; IS-M-735; CONF-930246-1) Avail: CASI HC A02/MF A01

Role of the geometrical parameters of the fibers and effects of fiber distribution in the matrix on the creep deformation behavior of 20 percent discontinuous fiber reinforced composite were numerically investigated, including the debonding and fiber pull-out mechanisms. During the analyses in the composite it is assumed that the matrix deforms with a power law creep relationship and the fibers are rigid. Results indicate that for a given fiber geometry and distribution parameters in the matrix, an increase in the interfacial strength or an increase in the work of separation per unit area of interface reduces the secondary creep rates. For even very weak interface characteristics, it is possible to achieve lower secondary creep rates and delayed interface failure by suitable selection of the geometrical parameters of the fibers and by controlling the distribution of the fibers in the matrix. DOE

N93-24053# Aeronautical Research Labs., Melbourne (Australia).

DESIGNING FOR DAMAGE TOLERANT COMPOSITE REPAIRS

W. K. Chiu, D. Rees, P. Chalkley, and R. Jones Oct. 1992 44 p

(AD-A260094; ARL-STRUC-R-448; DODA-AR-007-070) Avail: CASI HC A03/MF A01

This paper presents a design methodology, and the associated data base, for the damage tolerant design of adhesively bonded repairs. This methodology is illustrated by considering repairs to an edge cracked panel and to multi-site damage in a fuselage lap joint. GRA

N93-24103 Drexel Univ., Philadelphia, PA.

VISCOELASTIC PROPERTIES OF 3-D BRAIDED PEEK/GRAPHITE COMPOSITES Ph.D. Thesis

Jia-Ni Chu 1992 158 p

Avail: Univ. Microfilms Order No. DA9305293

Three-dimensional braided PEEK/AS4 graphite composites were preformed and processed to investigate the viscoelastic behavior of this new system. These manufactured composites were characterized to determine their fiber volume fractions and matrix crystallinity indices using matrix digestion and wide angle x-ray diffraction. After physical characterization, the mechanical response of these composites was evaluated at various temperatures. Experimental results from tensile measurements were compared to an established fabric geometry model (FGM). This model predicts tensile modulus based upon fiber and matrix properties, fiber volume fraction, and braiding angle. Model predictions and experimental results are given and are in good agreement with each other. In order to study the time-dependent mechanical properties of these 3-D braided composites, their stress relaxation, creep and dynamic mechanical properties were evaluated. These results were then compared to a new composite model. This model combined a Quasi-linear Viscoelastic Model (QVM) for the viscoelastic behavior of PEEK with the FGM approach to predict the viscoelastic behavior of 3-D PEEK composites. The experimental stress relaxation and creep results are in good agreement with the QVM-FGM analysis. Thus, the QVM-FGM approach was used to accurately correlate these viscoelastic properties of 3-D braided PEEK/graphite composites. Through wider use and testing, this QVM-FGM approach may be used to increase our understanding and perhaps facilitate the design of composite structures. Dissert. Abstr.

N93-24181 Rhode Island Univ., Kingston.

EFFECT OF REINFORCEMENT AND FIBER-MATRIX INTERFACE ON DYNAMIC FRACTURE OF FIBER-REINFORCED COMPOSITE MATERIALS Ph.D. Thesis

Sanjeev Kumar Khanna 1992 173 p

Avail: Univ. Microfilms Order No. DA9239568

The experimental technique of dynamic photoelasticity coupled with high speed photography was used to study the interaction of running cracks with brittle and ductile fibers embedded in a brittle polymeric matrix. The effect of reinforcement and the fiber-matrix interface on dynamic stress intensity factor, crack bridging phenomena, crack surface morphology, and toughening mechanisms occurring during dynamic fracturing of reinforced brittle matrix composites was investigated. It is found that reinforcement reduces the crack velocity and the stress intensity factor. Thus the energy supplied to the crack tip is reduced resulting in reduction of the crack jump distance. Fiber pullout experiments were done to characterize the fiber-matrix interface. Rapid pullout results in an increase in interface shear strength. For rapid pullout of fibers the difference between maximum pullout loads, for well and weakly bonded fibers, is much smaller than for very slow pullout. A fiber-matrix interface which is weaker in the vicinity of the crack path, termed the partly debonded interface, produces higher crack closing forces and lower stress intensity factor compared to well bonded fibers. The former interface condition results in low fracture energy and shorter crack jump compared to the later. The interface condition significantly affects the fracture surface morphology. The fracture surface roughness is lower for reinforced materials compared to monolithic. Further the partly debonded fibers result in lower surface roughness compared to the well bonded fibers. Inclined fibers with various interface conditions have no significant effect on the stress intensity factor. The fiber debonded length, however, decreases, as compared to fibers which are aligned with the loading direction, due to the kinking of the fibers. The dynamic stress field and strain field equations developed for orthotropic composite materials were used to determine the stress intensity factor for running cracks in a high fiber volume fraction glass-epoxy composite laminate, using the method of strain gages. The determination of the optimum location and orientation of the strain gages is described. Dissert. Abstr.

N93-24206 Carnegie-Mellon Univ., Pittsburgh, PA.

MODELING THE THERMAL PROPERTIES AND PROCESSING OF COMPOSITE MATERIALS Ph.D. Thesis

Rangarajan Pitchumani 1992 120 p

Avail: Univ. Microfilms Order No. DA9238826

The manufacture of partially cured, thermoset matrix composite systems is modeled. A generalized analysis, applicable to almost all the fiber-resin systems encountered in practice, is carried out in terms of four key dimensionless groups formed of the process and the product parameters - (1) the Damkohler number (K(sub o)) which is a relative measure of the conduction and the reaction time scales, (2) the dimensionless activation energy (E(sub o)), (3) the adiabatic reaction temperature (B(sub o)) which represents the temperature rise potential in the composite due to the heat of the cure reaction, and (4) the Biot number (B(sub i)) which characterizes

the post-cure convective cooling of the composite product. Optimal cure cycles which yield a homogeneous cure in the composite, are obtained as a function of the dimensionless parameters. Design plots for the optimal cure temperature and duration are presented. Their use in practical situations is illustrated in the context of a commercially available graphite-epoxy prepreg from Hercules, which is widely used in the aerospace industry. The thermal properties of the composite namely, the transient thermal diffusivity and the steady state thermal conductivity, are essential parameters in the process modeling studies, as well for the design of composite materials for several high temperature applications. Transient heat conduction in fibrous composites is investigated with the aim of devising a criterion for the validity of the analysis of composite materials as homogeneous media having the effective thermal properties. A homogeneity criterion based on the composite thickness is derived in terms of the fiber volume fraction and the fiber diameter. The criterion, which is the first of its kind for fibrous composites, is valid in the practical range of composite parameters. An analytical means for evaluating the effective thermal diffusivity is also presented. Steady state heat conduction in both fiber-reinforced composites as well as particulate reinforced extruded composites is addressed. In the case of fibrous composites, an approach to estimating the thermal conductivity of systems having ordered or disordered arrangement of fibers is proposed. This analytical approach uses local fractal techniques to reduce the geometric complexity of the fiber arrangements and correlates a given fiber geometry to the effective thermal conductivity. The method is shown to be powerful in predicting the composite conductivities in real-world situations. In the case of three-dimensional particulate reinforced composites, a simplified model is developed for predicting the anisotropic composite conductivities. The model exploits the microstructural information available from scanning electron microscopy, and is based on the concept of a unit cell. Good agreement is demonstrated between the theoretical model-predictions and experimental data obtained using eddy current techniques, for a wide range of composite systems and reinforcement volume fractions. Author

N93-24217 Drexel Univ., Philadelphia, PA.
TIME-TEMPERATURE ANALYSIS OF DAMAGE INITIATION AND GROWTH IN COMPOSITE LAMINATES Ph.D. Thesis
Suresh Nagesh 1992 137 p
Avail: Univ. Microfilms Order No. DA9237891

Polymer-based composites are used in aerospace structures due to their high strength to weight ratio. However, polymers also exhibit time-dependent behavior and this behavior may in turn be affected by high temperature and humid environments. Long-term effects manifest themselves in the form of loss of stiffness and/or strength. And, in this regard, the contributing factors could stem from the time-dependent material behavior as well as the accumulation of damages in time. Clearly, a generic methodology is needed which addresses the fundamental issues caused by both of the contributing factors. The objective of the present study is to investigate the time-dependent damage initiation and growth behavior associated with the various sublaminate damage modes in polymer-based composites. A quasi-three dimensional finite element procedure is first developed based on the linear theory of viscoelasticity for simulating sublaminate damages in composite laminates. Specifically the unidirectional plies of the laminate are represented by a set of linear anisotropic, viscoelastic constitutive relations. Damage modes in the forms of transverse cracks, delamination, or fiber-wise splitting are incorporated in the analysis by means of appropriately evolving local boundary conditions. Calculation of the stress fields and fracture parameters such as the strain energy release rates (G) and the stress intensity factors (K) associated with the different modes of damage and at different stages of evolution are also made a part of the routine. Numerical solutions are obtained by a convolution as well as a quasi-elastic technique. To illustrate the applicability of the numerical routine, the problem of fiber-wise splitting is chosen. Since fiber-wise splitting is a mixed-mode type of failure, an appropriate mixed-mode fracture criterion is needed for predicting its onset and growth. An effort is then made to develop such a criteria, based on experimental data using several aerospace grade graphite-epoxy composite systems. The finite element procedure in conjunction with the fracture criterion is then used to simulate fiber-wise splitting experiments that were conducted previously. Good correlation between the predicted results and the experimental results was obtained. Dissert. Abstr.

N93-24316# Illinois Univ., Urbana. Center for Composite Materials Research.
THICK-SECTION STRUCTURAL COMPOSITES AND COMPOSITE STRUCTURES Technical Report, 15 Sep. 1986 - 30 Dec. 1991
James Economy Mar. 1992 59 p
(Contract N00014-86-K-0799)
(AD-A260081) Avail: CASI HC A04/MF A01

A key objective of the ONR-URI Center is to conduct basic research on critical materials science, mechanics, and structural problems currently confronting the Navy and to be encountered in its future use of advanced composite materials. The current emphasis of the Center's research thrust is placed on thick-section structural composites and composite structures, since these subjects have been identified as major potential problem areas of concern in the present and future high-performance Navy structural systems. The research program had three major thrusts, namely: (1) Materials design and selection. (2) Processing of thick filament would cylinders. (3) Mechanical behavior of thick section composites. GRA

N93-24468# Toronto Univ. (Ontario).
MESOMECHANICAL MODEL FOR FIBRE COMPOSITES: THE ROLE OF THE INTERFACE Final Report, 1 Jun. 1989 - 31 May 1992
Michael R. Piggott 31 Jul. 1992 44 p
(Grant AF-AFOSR-0365-89)
(AD-A260195; AFOSR-93-0017TR) Avail: CASI HC A03/MF A01

This work was initially conceived as providing a theoretical framework linking microphenomena and macroscale properties in fiber composites. In addition, experimental data were to be obtained to lend substance to the theoretical constructs. Experiments were therefore carried out on the interface, and on composites which were particularly sensitive to interfacial effects, i.e., those containing short aligned fibers. Pull out tests were used for interface studies. These showed that most fiber-polymer interphases were strong (usually stronger than the polymer) and brittle. This brittleness was an important observation which goes a long way towards explaining the properties of fiber composites containing many fiber ends. Short aligned fiber composites were manufactured, with carbon fibers having lengths of 0.5, 1.0, 2.0 and 4.0 mm. Alignment was not perfect, nor were fiber lengths all equal to the nominal lengths, so both alignments and lengths were checked in the actual composites. Composite strengths and Young's moduli were measured and compared with predictions based on slip and shear lag theory. The agreement for moduli was moderately good, but for strengths it was very poor. Since, in addition, the stress strain plots were straight, the slip theory is not supported at all by this work. Instead, it appears highly likely that a mesomechanical theory involving crack initiation and development would work much better. Theoretical development led to the concept of the mesostructure as a basis for mesomechanical analysis. The mesostructure was defined as adventitious small-scale structures which are present in fiber composites, but normally neglected, such as fiber waviness and uneven packing. GRA

N93-24597* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CONTINUOUS FIBER THERMOPLASTIC PREPREG Patent
Maywood L. Wilson, inventor (to NASA) and Gary S. Johnson, inventor (to NASA) 27 Apr. 1993 10 p Filed 15 Nov. 1990 supersedes N91-15334 (29 - 7, p 972)
(NASA-Case-LAR-14459-1; US-Patent-5,205,898;
US-Patent-Appl-SN-613046; US-Patent-Class-156-441;
US-Patent-Class-118-124; US-Patent-Class-118-125;
US-Patent-Class-156-181; Int-Patent-Class-B05C-3/152;
Int-Patent-Class-B29B-15/12; Int-Patent-Class-B29C-67/14) Avail: US Patent and Trademark Office

A pultrusion machine employing a corrugated impregnator vessel to immerse multiple, continuous strand, fiber tow in an impregnating material, and an adjustable metered exit orifice for the impregnator vessel to control the quantity of impregnating material retained by the impregnated fibers, is provided. An adjustable height insert retains transverse rod elements within each depression of the corrugated vessel to maintain the individual fiber tows spread and in contact with the vessel bottom. A series of elongated heating dies, transversely disposed on the pultrusion machine and having flat heating surfaces with radiused edges, ensure adequate temperature exposed dwell time and exert adequate pressure on the impregnated fiber tows, to provide the desired thickness and fiber/resin ratio in the prepreg

formed. The prepreg passing through the pulling mechanism is wound on a suitable take-up spool for subsequent use. A formula is derived for determining the cross sectional area opening of the metering device. A modification in the heating die system employs a heated nip roller in lieu of one of the pressure applying flat dies.

Official Gazette of the U.S. Patent and Trademark Office

N93-24651# Institute for Aerospace Research, Ottawa (Ontario). Structures and Materials Lab.

EFFECTS OF PROCESSING PARAMETERS ON THE MICROSTRUCTURE OF A 30 W/O SiCw-2080 ALUMINUM COMPOSITE

F. Chartrand (Ecole Polytechnique, Montreal, Quebec.) and G. Lesperance (Ecole Polytechnique, Montreal, Quebec.) Jul. 1992 28 p

(Contract DSS-31946-9-0009/01-SR)

(NRC-IAR-CR-20; NRC-32156; CTN-93-60703) Avail: CASI HC A03/MF A01

A metal matrix composite (MMC) for potential aerospace applications was studied. The MMC was composed of silicon carbide whiskers (SiC(w)) and a new aluminum powder alloy specifically designed as a matrix for SiC particulate reinforced metal matrix composites (Alcoa 2080). The new alloy was reinforced with 30 percent by weight of SiC(w), using knowledge previously acquired with the powder processing of MMC's using aluminum alloy 7050. A microstructural analysis of the 2080 powder and the SiC(w) was carried out, and a series of experiments was designed to determine the effects of processing parameters on the quality of the bonding and the mechanical properties. The effects of incipient melting at particle boundaries during hot isostatic pressing were studied in particular, in contrast with the conventional solid state consolidation. A technique was successfully developed to produce a uniform distribution of SiC(w) in the matrix without clustering of the whiskers. The hot isostatically pressed unreinforced alloy was successfully extruded with a ratio of 16:1. However, the high strength of the composite has so far prevented extrusion even at temperatures exceeding those normally used for hot working. Author (CISTI)

N93-22112*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CERAMIC MATRIX COMPOSITES (CONTINUOUS FIBER REINFORCED) THERMAL PROTECTION SYSTEMS

Salvatore R. Riccitiello *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 385-389 (For primary document see N93-22081 08-16)

Avail: CASI HC A01/MF A04

N93-22650*# Alabama Univ., Huntsville. Consortium for Materials Development in Space.

CONSORTIUM FOR MATERIALS DEVELOPMENT IN SPACE INTERACTION WITH SPACE STATION FREEDOM

Charles A. Lundquist and Valerie Seaquist *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 567-573 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N93-22036* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

APPARATUS AND METHOD FOR CELLULOSE PROCESSING USING MICROWAVE PRETREATMENT Patent

Hatice S. Cullingford, inventor (to NASA), Clifford E. George, inventor (to NASA), and George R. Lightsey, inventor (to NASA) 23 Mar. 1993 7 p Filed 5 Jul. 1991 Supersedes N92-19486 (30 - 10, p 1585)

(NASA-Case-MSC-21936-1-SB; US-Patent-5,196,069;

US-Patent-Appl-SN-728901; US-Patent-Class-127-37;

US-Patent-Class-127-1; US-Patent-Class-127-2; US-Patent-Class-162-72;

US-Patent-Class-162-76; US-Patent-Class-162-50;

Int-Patent-Class-C13K-1/02) Avail: US Patent and Trademark Office

A method for pretreating a cellulosic waste product with microwaves is disclosed as well as a method and apparatus for converting cellulosic waste into soluble saccharides. The invention greatly enhances a reaction rate for enzymatic hydrolysis. A feed mixture of cellulose, water, and acetic acid are irradiated with microwaves at a superatmospheric pressure in an autoclave reaction vessel and the treated cellulose is enzymatically hydrolyzed in a bioreactor. The acid and enzymes are optionally separated for reuse. As a feed stock for the culture of microbes, the sugars can be further processed into ethanol, or food protein. High yield, low hazard potential, low energy usage, and ready preparation in space of acetic acid and the enzyme makes the present invention well suited for use on long duration space missions.

Official Gazette of the U.S. Patent and Trademark Office

N93-22055# Cornell Univ., Ithaca, NY.

REACTION AND DIFFUSION IN TURBULENT COMBUSTION

S. B. Pope 2 Oct. 1992 20 p

(Contract DE-FG02-90ER-14128)

(DE93-006185; DOE/ER-14128/2) Avail: CASI HC A03/MF A01

Progress was made on the following: (1) development of two-variable (xi - y) thermochemistry suitable for DNS (direct numerical simulation) studies; (2) determination of laminar flame properties based on this thermochemistry; (3) determination of the parameter range that can be accessed by DNS with good resolution; (4) implementation of the thermochemistry in the DNS code; (5) performance of exploratory simulations, and the development of techniques of relating Eulerian DNS data to turbulent combustion theories; (6) implementation of the DNS code on parallel and distributed computers; and (7) the study of relative molecular motion in turbulence. DOE

N93-22056# National Inst. of Standards and Technology, Gaithersburg, MD. Thermophysics Div.

THERMOPHYSICAL PROPERTIES Quarterly Report, 1 Jul. - 30 Sep. 1992

Richard F. Kayser Oct. 1992 101 p Prepared for Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA

(Contract DE-FG02-91CE-23810; ARTI-MCLR Proj. 650-50800)

(DE93-006427; DOE/CE-23810/4A) Avail: CASI HC A06/MF A02

Numerous fluids have been identified as promising alternative refrigerants, but much of the information needed to predict their behavior as pure fluids and as components in mixtures does not exist. In particular, reliable thermophysical properties data and models are needed to predict the performance of the new refrigerants in heating and cooling equipment, and to design and optimize equipment to be reliable and energy efficient. Objective of this project is to provide highly accurate, selected thermophysical properties data for Refrigerants 32, 123, 124, and 125, and to use these data to fit simple and complex equations of state and detailed transport property models. The new data fills gaps in the existing data sets and resolve the problems and uncertainties that exist in and between the data sets. The progress made during the third quarter of this fifteen-month project, which was initiated in late Jan. 1992 is described. DOE

N93-22057# Akron Univ., OH. Inst. of Polymer Science.

COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH ELASTOMERS

G. R. Hamed and R. H. Seiple Oct. 1992 140 p

(Contract DE-FG02-91CE-23810)

(DE93-006429; DOE/CE-23810/4C) Avail: CASI HC A07/MF A02

Information provided is designed to assist the air-conditioning and refrigeration industry in the selection of suitable elastomeric gasket and seal materials that will prove useful in various refrigerant and refrigeration lubricant environments. 97 percent of the swell measurements have been made to date. The other 3 percent of the measurements are contingent on the availability of additional quantities of R-32. Swell behavior in the fluids were determined using weight and in situ diameter measurements for the refrigerants and weight, diameter, and thickness measurements for the lubricants. Weight and diameter measurements are repeated after 2 hours and 24 hours for samples removed from the refrigerant test fluids and 24 hours after removal from the lubricants. DOE

N93-22073# Technical Research Centre of Finland, Espoo. Metallilab.
CATALYTIC COMBUSTION OF HYDROGEN [VEDYN KATALYYTTINEN PALAMINEN]
Hannele Tonteri and Seppo Taehtinen 1992 37 p In FINNISH
(DE93-752854; VTT-TIED-1321) Avail: CASI HC A03/MF A01

Hydrogen catalytic combustors are advantageous because they release heat at lower temperatures than flame combustors. Low operation temperature and flameless burning make the process safe. The combustion temperature can be controlled continuously by changing the hydrogen flow rate. The combustion gas of a hydrogen catalytic combustor is water vapour, and if it is burned with air, certain amounts of nitrogen oxides may also occur. Commercial applications are in the area of gas monitors for combustible gases. Applications for hydrogen catalytic combustion are predicted to increase in household heaters, cooking devices, and industrial drying and heating processes. Further research of hydrogen catalytic combustors is concerned with increasing their power and reliability. The literature review of this report describes catalytic combustion and specifically hydrogen catalytic combustion. The construction of hydrogen catalytic combustors and different catalytic materials are explained. Some examples of commercial or near commercial applications are shown. An experimental construction was built to run a 50W open catalytic combustor. The maximum operating temperature of 164 C was reached with hydrogen flow rate 15 l/h. The temperature was easily controlled by changing the hydrogen flow rate. The combustion efficiency reached in these tests was 95 percent. DOE

N93-22339# Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV.
ISOTOPE IDENTIFICATION OF PURIFIED XENON AND KRYPTON BY LOW-BACKGROUND GAMMA SPECTROSCOPY
1992 8 p Presented at the Joint Conference of the Society for Experimental Mechanics, Inc. and the American Society for Nondestructive Testing, Inc., Chicago, IL, 16-20 Nov. 1992
(Contract DE-AC08-89NV-10630)
(DE93-004585; CONF-921111-6) Avail: CASI HC A02/MF A01

At the Nevada test site, environmental air samples are routinely analyzed for radioxenon and radiokrypton. These noble gases are separated and purified using a cryogenic gas-solid chromatography method developed by US EPA, Environmental Monitoring and Support Laboratory-Las Vegas. Each component is routinely counted by liquid scintillation. Routine counting is accomplished by liquid scintillation. Low-level gamma spectrometry is used to verify activity and/or identify isotopes present. If liquid scintillation results are observed above background, low-level gamma spectrometry identifies other gamma-emitters. DOE

N93-22400# Oak Ridge National Lab., TN.
A ROUND-ROBIN FOR PARTICLE ELECTROPHORESIS STANDARDIZATION
M. A. Janney 1992 17 p Presented at the Engineering Foundation Conference on Dispersion and Aggregation, Palm Coast, FL, 15-20 Mar. 1992
(Contract DE-AC05-84OR-21400)
(DE93-003018; CONF-9203138-2) Avail: CASI HC A03/MF A01

The ability to measure the electrophoretic mobility (EM) of solid particles in a repeatable manner is critically important in the specification of ceramic powders for advanced heat engines. A joint research project conducted by ORNL, Rutgers University, the University of Florida, and the University of Wisconsin to standardize EM measurements has been completed. Its purpose was to define the procedures by which repeatable, inter-laboratory, capillary microelectrophoretic mobility, and pH measurements could be made on ceramic powders in aqueous suspension. Both 'model' colloids and silicon nitride ceramic powder were evaluated. 'Model' systems were considered as potential standards for the initial calibration and check-out of mobility measurements at the four laboratories. These included surface-treated and unmodified polymer lattices, phosphated goethite, and red blood cells. The results indicate that phosphated goethite is the best standard material. The suspensions were stable for many months; they were easy to measure; and, their zero-mobility pH's were predictable based on the phosphate addition level. Interlaboratory agreement of mobility vs pH was excellent. Following the work on goethite, a study of the mobility of silicon nitride was conducted. This work showed that repeatable interlaboratory measurements could be made on silicon nitride, a ceramic system that exhibits significant aging in aqueous suspension. Lessons learned from the goethite experience were invaluable in conducting the measurements on silicon nitride. DOE

N93-22415# University of Southern California, Los Angeles. Dept. of Chemistry.
COMBUSTION-RELATED STUDIES USING WEAKLY-BONDED COMPLEXES
R. A. Beaudet Mar. 1992 26 p
(Contract DE-FG03-89ER-14053)
(DE93-005250; DOE/ER-14053/T3) Avail: CASI HC A03/MF A01

This research program is concerned with microscopic-level phenomena that are important in combustion; weakly bonded adducts formed in supersonic expansions are studied spectroscopically and used to limit the angles and impact parameters of bimolecular encounters. Species in which a free radical such as atomic oxygen is bonded to a stable molecule in a shallow well outside the reaction barrier are investigated. Tunable diode laser IR absorption spectroscopy is used to study the complexes of interest. DOE

N93-22423# Texas A&M Univ., College Station. Dept. of Chemistry.
CORRELATIONS BETWEEN SURFACE STRUCTURE AND CATALYTIC ACTIVITY/SELECTIVITY
D. W. Goodman Oct. 1992 20 p
(Contract DE-FG05-88ER-13954)
(DE93-005884; DOE/ER-13954/4) Avail: CASI HC A03/MF A01

The objective is to address the keys to understanding the relation between surface structure and catalytic activity/selectivity. Of concern are questions related to enhanced catalytic properties of mixed-metal catalysts and critical active site requirements for molecular synthesis and rearrangement. The experimental approach utilizes a microcatalytic reactor contiguous to a surface analysis system, an arrangement which allows in vacuo transfer of the catalyst from one chamber to the other. Surface techniques being used include Auger (AES), UV and X-ray photoemission spectroscopy (UPS and XPS), temperature programmed desorption (TPD), low energy electron diffraction (LEED), high resolution electron energy loss spectroscopy (HREELS), and infrared reflection-absorption spectroscopy (IRAS). Our research program builds upon our previous experience relating the results of single crystal kinetic measurements with the results obtained with supported analogs. We are also exploiting our recent work on the preparation, the characterization, and the determination of the catalytic properties of ultra-thin metal and metal oxide films. The program is proceeding toward the following studies: the unique catalytic properties of ultrathin metal films; the investigation of the critical ensemble size requirements for principal catalytic reaction types; and the modelling of supported catalysts using ultra-thin planar oxide surfaces. DOE

N93-22431# Lehigh Univ., Bethlehem, PA. Center for Surface Studies.
METHANE OXIDATION OVER DUAL REDOX CATALYSTS
K. Klier, R. G. Herman, Z. Sojka, J. I. DiCosimo, and S. DeTavernier Jun. 1992 135 p
(Contract DE-FG21-89MC-26039)
(DE92-012454; DOE/MC-26039/3111) Avail: CASI HC A07/MF A02

Catalytic oxidation of methane to partial oxidation products, primarily formaldehyde and C2 hydrocarbons, was found to be directed by the catalyst used. In this project, it was discovered that a moderate oxidative coupling catalyst for C2 hydrocarbons, zinc oxide, is modified by addition of small amounts of Cu and Fe dopants to yield fair yields of formaldehyde. A similar effect was observed with Cu/Sn/ZnO catalysts, and the presence of a redox Lewis acid, Fe(sup 3) or Sn(sup 4), was found to be essential for the selectivity switch from C2 coupling products to formaldehyde. The principle of double doping with an oxygen activator (Cu) and the redox Lewis acid (Fe, Sn) was pursued further by synthesizing and testing the CuFe-ZSM-5 zeolite catalyst. The Cu(sup 2)(ion exchanged) Fe(sup 3)(framework)-ZSM-5 also displayed activity for formaldehyde synthesis, with space time yields exceeding 100 g/h-kg catalyst. However, the selectivity was low and earlier claims in the literature of selective oxidation of methane to methanol over CuFe-ZSM-5 were not reproduced. A new active and selective catalytic system (M = Sb,Bi,Sn)/SrO/La2O3 has been discovered for potentially commercially attractive process for the conversion of methane to C2 hydrocarbons, a new principle has been demonstrated for selectivity switching from C2 hydrocarbon products to formaldehyde in methane

oxidations over Cu,Fe-doped zinc oxide and ZSM-5, and a new approach has been initiated for using ultrafine metal dispersions for low temperature activation of methane for selective conversions. DOE

N93-22463 National Physical Lab., Teddington (England). Materials Metrology Div.

SCATTERING IN ELECTRON SPECTROMETERS, DIAGNOSIS, AND AVOIDANCE. 1: CONCENTRIC HEMISPHERICAL ANALYSERS

M. P. Seah Jul. 1992 23 p

(NPL-DMM(A)-70; ETN-93-93548) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Part of a study developing three methods to analyze the extent to which unwanted scattering of electrons occurs in electron spectrometers and how to reduce it to an insignificant level is presented. The three diagnostic methods involve the measurement of either: the region of the M(sub 4,5) VV Auger Electron (AE) peaks from Ag in AES (AE Spectroscopy); the reflection of an electron beam from a biased sample; or the 3d(sub 1/2) photoelectron peak from Ag irradiated with MgK(alpha) x-rays. Analyses were made for concentric hemispherical analyzers. Scattering contributions appear to arise from high energy electrons which strike the outer hemisphere giving rise to a spectrum of secondary electrons. These cause the scattered electron contribution to vary approximately as Ep(exp -2.43), where Ep is the pass energy, to increase approximately in proportion to the spectrometer input slit area for AES studies, to fall approximately inversely with an increase in the lens magnification from 1 to 3, and in the constant Delta(E) mode, to increase with the analyzed electron energy. Thus, for each lens magnification, there exists a range of slits and pass energies for which the scattering may be maintained at less than 1 percent. In the constant Delta (E) mode, pass energies of 50 eV or more are generally safe whereas, in the constant Delta(E)/E mode, retardation ratios of 4 or less are required. ESA

N93-22464 National Physical Lab., Teddington (England). Materials Metrology Div.

SCATTERING IN ELECTRON SPECTROMETERS, DIAGNOSIS, AND AVOIDANCE. 2: CYLINDRICAL MIRROR ANALYSERS

M. P. Seah Jul. 1992 29 p

(NPL-DMM(A)-71; ETN-93-93549) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

An analysis of the effects leading to an unwanted scattered background of electrons in Cylindrical Mirror Analyzers (CAM's) is presented as a complement to part 1 on concentric hemispherical analyzers. Scattering from the middle region of the inert surface of the mirror electrode is shown to be significant but the amount of scattering reaching the detector may be reduced by reducing the area of the output slit or by adding a deflection post filter to the optics as occurs in some commercial instruments. Internal scattering causes a higher background so that peak to background ratios are attenuated and so that transmission function calibrations involve a systemetic error. Evidence for this error is a step in the calibration curves for I(E)/En(E) established earlier. The steps appearing in the curves for Cu and Ag reference samples give a direct measure of the scattering intensity. Calibration plots are established for this purpose. Results from previous interlaboratory comparisons are analyzed showing that in commercial CMA's with large area energy selection slits the scattering may reach 35 percent of the copper true background at 950 eV, complicating the subsequent use of the data. Concentric hemispherical analyzers and some commercial CMA's show very low scattering. In some CMA's, the analog detection systems also cause an enhanced background similar and in addition to scattering, boosting the above figure of 35 to 100 percent. ESA

N93-22505# Sandia National Labs., Albuquerque, NM.

POROUS MATERIALS BY DESIGN. PLASMA OXIDATION OF HYDROCARBON TEMPLATES IN POLYSILSESQUIOXANES

D. A. Loy, R. J. Buss, R. A. Assink, K. J. Shea (California Univ., Irvine.), and H. Oviatt (California Univ., Irvine.) 1992 10 p Presented at the 205th American Chemical Society National Meeting, Denver, CO, 28 Mar. - 2 Apr. 1993. - 2 Apr. 1993

(Contract DE-AC04-76DP-00789)

(DE93-005372; SAND-92-2522C; CONF-930304-1) Avail: CASI HC A02/MF A01

Arylene- and alkylene-bridged polysilsesquioxanes were prepared by sol-gel processing of bis(triethoxysilyl)-aryl monomers and decyl monomer. The arylene polysilsesquioxanes were porous materials with surface areas as high as 830 m(exp 2)/g (BET). Treatment with an inductively coupled oxygen plasma resulted in the near quantitative removal of the arylene bridging groups and a coarsening of the pore structure. Solid state Si-29 NMR was used to confirm the conversion of the sesquioxane silicons (T) to silica (Q). The decylene-bridged polysilsesquioxane was a non-porous material. Oxygen plasma treatment afforded a silica gel with a surface area of 294 m(exp 2)/g and a mean pore diameter of 46 A. The porosity in the silica gel appears to arise entirely from the oxidation of the 1,10-decylene spacer. DOE

N93-22515# Yale Univ., New Haven, CT.

HOMOLYTIC ACTIVATION OF HYDROCARBONS AND HYDROGEN BY PERSISTENT RADICALS

1993 8 p

(Contract DE-FG02-90ER-14122)

(DE93-007013; DOE/ER-14122/1) Avail: CASI HC A02/MF A01

New synthetic methods for preparing persistent transition metal-centered radicals were developed, based on ligand addition reactions of triphenylmethyl complexes. Preliminary study indicates that they will react under mild conditions with substrates such as hydrogen and certain hydrocarbons. The chemistry was extended to biradicals. Mechanism and selectivity of the novel reactions are being studied. Extensions and modification of synthetic methods to provide addition persistent radicals are proposed; more general methodologies including the reduction of metal halides are also being developed. DOE

N93-22520# Sandia National Labs., Albuquerque, NM.

COMPUTER-AIDED DESIGN OF MOLECULAR CATALYSTS FOR ALKANE OXIDATION USING DODECA-SUBSTITUTED IRON PORPHYRINS

J. A. Shelnutt, S. L. Martinez, and K. E. Erkkila 27 Oct. 1992 18 p Presented at the US DOE Contractors Review on Liquefaction, Pittsburgh, PA, 22-24 Sep. 1992

(Contract DE-AC04-76DP-00789)

(DE93-004046; SAND-92-2302C; CONF-920953-2) Avail: CASI HC A03/MF A01

Recent progress in the design, synthesis, and activity testing of catalysts for partial oxidation of light alkanes is described. The first testing results for the designed halogenated dodeca-substituted iron-porphyrin catalysts are presented. The results validate the design goals selected and suggest improvements to the current catalyst designs. DOE

N93-22697# Ecole Centrale de Lyon (France). Lab. de Machines Thermiques.

CONTRIBUTION TO THE STUDY OF SOOT FORMATION IN COMBUSTION ENVIRONMENTS BY OPTICAL METHODS BASED ON LIGHT DIFFUSION Ph.D. Thesis [CONTRIBUTION A L'ETUDE DE LA FORMATION DE LA SUIE DANS LES MILIEUX EN COMBUSTION PAR LES METHODES OPTIQUES BASEES SUR LA DIFFUSION DE LA LUMIERE]

Naceur Ayachi 1991 166 p In FRENCH Sponsored by Agence Francaise pour la Maitrise de l'Energie and Regie Nationale des Usines Renault

(ECL-91-26; ETN-93-91955) Avail: CASI HC A08/MF A02

A study on oxidation and soot formation in hydrocarbon combustion, to aid engine designers in defining the most adequate pollutant reduction processes and in developing soot production models for use in parametric study computation codes, is presented. The state of the art of this field is reviewed, and the morphology, crystal structure in soot particles, and the principal steps in their formation are described. Different combustion systems, in particular the diesel engine, are reviewed. The theory of light diffusion is used for characterization of the soot. The theory and applications of electromagnetic scattering are recalled. This method is used on a simple configuration of laminar diffusion flame. Applied to a diesel engine, this measurement method gives the diameter and concentration of soot particles in the combustion chamber. Light attenuation measurements can determine the mean value of the voluminal fraction over one crossing of the combustion chamber. With these measurements, the spatial and temporal distribution of the soot and the influence of inlet air temperature are studied. Wider utilization possibilities of the experimental tool are discussed. ESA

N93-22709# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

MECHANISMS AND ENHANCEMENT OF FLAME STABILIZATION

C. K. Law 1993 7 p

(Contract DE-FG02-89ER-13988)

(DE93-006467; DOE/ER-13988/5) Avail: CASI HC A02/MF A01

During the reporting period, useful contributions have been made in understanding the structure of laminar premixed and diffusion flames, with emphasis on the influence of aerodynamics and chemical kinetics. These contributions include: (1) derivation of the missing closure condition for the activation energy asymptotic analysis of premixed flames; (2) identification of a dual extinction mode for radiation-affected flames; (3) formulation of a unified theory of fundamental flammability limits; and (4) demonstration that flame stabilization can be achieved in the absence of heat loss. These investigations have been conducted via experimental, analytical and computational approaches, with strong coupling between the individual components. DOE

N93-22731# Office of Naval Research, Arlington, VA.

PHOTOCHEMICAL OBSERVATION OF ION FLOWS IN MEMBRANE CHANNELS Final Report

Michael E. Starzak 22 Dec. 1992 11 p

(AD-A259869) Avail: CASI HC A03/MF A01

Laser Doppler velocimetry is applied to a study of the synchronous motions of ions in membranes and membrane channels. The technique provides direct measurements, for example, of local velocities within gramicidin channels and these measurements can be used to elucidate the kinetic mechanism of ion flows in such channels. The laser Doppler experiments yield data which suggest that ion motions in the channel are regular, i.e. the ions move at a steady velocity with some fluctuations about this velocity due to the molecular structure of the channel. Standard electrochemical measurements give no detailed information about such motions within the channels and, because of this lack of information, many multiparameter mechanisms have been postulated to describe the intrachannel kinetics. Since the number of 'fitting' parameters is often large with respect to the available data, many models can be fitted to the data and it is extremely difficult to prove a permeation mechanism. With the detailed velocity distribution for ions in the channel, it becomes possible to differentiate the various mechanisms for ion permeation and develop a consistent mechanism for ion permeation in a specific channel. GRA

N93-22736# Engineering Resources, Inc., Fayetteville, AR.

BIOLOGICAL PRODUCTION OF HYDROGEN

E. C. Clausen, J. L. Gaddy, and C. W. Ko 1992 13 p Presented at the US Department of Energy Contractors Review Meeting on Gasification and Gas Stream Cleanup Systems, Morgantown, WV, 15-17 Sep. 1992

(Contract DE-FG05-90ER-81057)

(DE93-002604; DOE/ER-81057/93/C0107; CONF-920951-15) Avail: CASI HC A03/MF A01

All Phase 1 objectives were satisfactorily achieved. Stoichiometric yields of hydrogen were obtained from CO with R. rubrum. Fast growth was observed on synthesis gas only; however, growth was maximized with a small amount of yeast extract at 30 C and pH 7. Intrinsic kinetic parameters were determined and showed that fast hydrogen production rates are possible. The Phase 2 research program concentrated on defining the optimal culture and bioreactor for hydrogen production. To insure that the best possible system was developed, cultures were screened for enzyme activity and hydrogen production. Promising cultures were optimized for hydrogen yield and CO conversion. Bioreactors that achieved high mass transfer rates, as well as high cell concentrations, were studied. Advanced bioreactor concepts, such as solid-state fermentation, non-aqueous fermentation, and high pressure fermentation were applied to these reactors to enhance mass transport. Process design and economic evaluations of the various alternatives were used to guide the research program. A new bacterial culture has been isolated from natural sources which consumes CO rapidly and gives high hydrogen yields. The new isolate, ERIH2, is able to utilize a variety of sugars as growth substrates and, unlike R. rubrum, does not require light for growth. The yield of H2 by ERIH2 was 100 percent. Typical H2 yields by R. rubrum were 75-85 percent. DOE

N93-22742# Argonne National Lab., IL.

STRUCTURE OF MOLTEN IRON CHLORIDE

D. L. Price, M. L. Saboungi, Shinya Hashimoto (Houston Univ., TX.), and S. C. Moss (Houston Univ., TX.) Nov. 1992 9 p Presented at the 8th International Symposium on Molten Salts, St. Louis, MO, 17-22 May 1992

(Contracts W-31-109-eng-38; DE-FG05-87ER-45325)

(DE93-004814; ANL/MSD/CP-75065; CONF-9205102-4) Avail: CASI HC A02/MF A01

The structure of molten FeCl3 at 320 C has been measured with neutron diffraction at the Intense Pulsed Neutron Source. Results indicate that melting in FeCl3 is accompanied by a change in local structure from the octahedral environment of the Fe3(+) in the solid to an Fe2Cl(6) molecular liquid. This behavior is similar to that observed in AlCl3 and in contrast to that of YCl3 where an octahedral coordination is preserved on melting. DOE

N93-22824# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

COMPREHENSIVE MECHANISMS FOR COMBUSTION CHEMISTRY: AN EXPERIMENTAL AND NUMERICAL STUDY WITH EMPHASIS ON APPLIED SENSITIVITY ANALYSIS

F. L. Dryer and R. A. Yetter Jan. 1993 54 p

(Contract DE-FG02-86ER-13503)

(DE93-007258; DOE/ER-13503/T1) Avail: CASI HC A04/MF A01

Over the last three years, this program has made significant progress on a number of problems: (1) development of a data base for oxidation of the CO/H2/O2 system; (2) development and refinement of a comprehensive kinetic mechanism for the CO/H2/O2 system; (3) experiments on formaldehyde oxidation in the AFPR, comprehensive mechanistic studies inclusive of flow reactor results, and literature results from static reactors, shock tubes, and flames, and identification of elementary reactions needing further study; (4) mechanistic study of previously acquired APFR flow reactor data on ethanol oxidation, including an estimation of the branching ratios for C2H5OH + X, X= OH, H and identification of elementary reactions needing additional study; (5) completion and mechanistic evaluation of the first insitu optical diagnostic measurements of OH in the APFR; (6) determinations of uni-molecular decomposition rate for 1,3,5-Trioxane at 700 to 800 K;(7) seeded perturbation experiments on moist CO oxidation in flow reactors as a means to determine elementary rate constants for specific reactions; (7) determination of elementary rates for CH4 + OH (yields) CH3 + H2O at 1026 and 1140 K, and C3H6 + OH (yields) products at 1020 K; and (8) experimental studies of the H2/O2 reaction system in the VPFR at conditions between the extended second and third explosion limits. DOE

N93-22871# SRI International Corp., Menlo Park, CA.

GAS SEPARATION WITH GLASS MEMBRANES

D. L. Roberts, L. C. Abraham, Y. Blum, and J. D. Way May 1992 105 p

(Contract DE-AC21-88MC-25204)

(DE93-000217; DOE/MC-25204/3133) Avail: CASI HC A06/MF A02

The Department of Energy (DOE) is seeking to develop high temperature, high pressure inorganic membrane technology to perform a variety of gas separation processes to improve the efficiency and economics of advanced power generation systems such as direct coal-fueled turbines (DCFT) and the integrated gasification combined cycle process (IGCC). The temperatures encountered in these power generation systems are far above the temperature range for organic membrane materials. Inorganic materials such as ceramics are therefore the most likely membrane materials for use at high temperatures. This project focussed on silica glass fiber membranes made by PPG Industries (Pittsburgh, PA). The goals were both experimental and theoretical. The first objective was to develop a rational theory for the performance of these membranes. With existing theories as a starting point, a new theory was devised to explain the unusual 'molecular sieving' behavior exhibited by these glass membranes. An apparatus was then devised for making permeation performance measurements at conditions of interest to DOE (temperatures to 2000 F; pressures to 1000 psia). With this apparatus, gas mixtures could be made typical of coal combustion or coal gasification processes, these gases could be passed into a membrane test cell, and the separation performance determined. Data were obtained for H2/CO, N2/CO2, O2/N2, and NH3/N2 mixtures and for a variety of pure component gases (He, H2, CO2, N2, CO, and NH3). The most challenging part of the project turned out to be the

sealing of the membrane at high temperatures and pressures. An overview of the practical potential of these membranes and of inorganic membranes in general of DOE and other applications are presented. DOE

N93-22916# National Inst. of Standards and Technology, Gaithersburg, MD. Thermophysics Div.
THERMOPHYSICAL PROPERTIES
R. F. Kayser Jan. 1993 98 p
(Contract DE-FG02-91CE-23810)
(DE93-007807; DOE/CE-23810/8A) Avail: CASI HC A05/MF A02

Numerous fluids have been identified as promising alternative refrigerants, but much of the information needed to predict their behavior as pure fluids and as components in mixtures does not exist. In particular, reliable thermophysical properties data and models are needed to predict the performance of the new refrigerants in heating and cooling equipment and to design and optimize equipment to be reliable and energy efficient. The objective of this project is to provide highly accurate, selected thermophysical properties data for Refrigerants 32, 123, 124, and 125, and to use these data to fit simple and complex equations of state and detailed transport property models. The new data will fill gaps in the existing data sets and resolve the problems and uncertainties that exist in and between the data sets. This report describes the progress made during the fourth quarter of this fifteen-month project, which was initiated in late January, 1992. DOE

N93-22917# Dayton Univ., OH.
COMBUSTION AND HEAT TRANSFER STUDIES UTILIZING ADVANCED DIAGNOSTICS: FUELS DATA SETS Final Report, 27 Feb. 1991 - 30 Sep. 1992
D. R. Ballal, S. P. Heneghan, H. L. Imwalle, C. R. Martel, and T. F. Williams Nov. 1992 132 p
(Contract F33615-87-C-2767)
(AD-A260220; WL-TR-92-2113) Avail: CASI HC A07/MF A02

As the Air Force continues to advance engine technology, aviation fuel heat loading has steadily increased. Therefore, a thermally stable JP-8 fuel is required that can operate at higher temperatures than current fuels. This research program had two objectives: (1) to identify fundamental conditions of fuel thermal decomposition, and (2) to provide the data needed to develop and evaluate global chemistry and heat transfer models for predicting jet fuel thermal decomposition and deposition rate. The Fuels Data Sets that may be used by modelers in the industry and other laboratories for the evaluation and refinement of global chemistry and heat transfer models for predicting jet fuel deposition rates are presented. These data were obtained using a single-pass, single-tube heat exchanger called the Phoenix rig. More exhaustive information is available in the individual papers listed. All the data sets were prepared using Microsoft Excel V.4.0 for IBM PC-Compatible computers and are available on computer diskettes. GRA

N93-22989# Ames Lab., IA.
THE INFLUENCE OF CARBON DIOXIDE ON THE CATALYTIC OXIDATIVE COUPLING OF METHANE OVER A-La2O3 AND 2-La2O2CO3 Ph.D. Thesis
R. P. Taylor Sep. 1992 170 p
(Contract W-7405-eng-82)
(DE93-004800; IS-T-1615) Avail: CASI HC A08/MF A02

Previous work correlated oxycarbonate and ability of La oxide-based materials to promote the oxidative coupling of methane (OCM). Since A-La2O3 and 2-La2O2CO3 may be prepared from each other by loss and gain of CO2 at 415 to 970 C, influence of CO2 on OCM process is of great interest. This work found that co-feeding CO2 over pure A-La2O3 and 2-La2O3CO3 starting materials depresses catalytic performance by both decreasing the catalyst ability to activate methane and inhibiting the homogeneous reaction pathway of ethane dehydrogenation. Superior catalytic performance was found to depend on presence of both A-La2O3 and 2-La2O2CO3. Both A-La2O3 and 2-La2O2CO3 starting materials were found to uptake CO2 between (LaO)(2)(sup 2+) layers. CO2 uptake by 2-LaO2CO3 was greater due to open structure along c axis. Isotopic labeling revealed that the CO2 used in preparing 2-La2O2CO3 from A-La2O3 inserts directly into oxide layers of A-La2O3 to give layers of (CO3(sub 2-)) anions. CO2 evolved during thermal decomposition of 2-La2O2CO3 originates from the same (CO3)(sub 2-) layers of the oxycarbonate. During OCM, C atoms originating in 2-La2O2CO3 were detected in products CO and CO2, but not in the coupling products. Therefore, ethane and ethylene are produced only via methane coupling. The O atoms originating in the (CO3)(sup 2-) layers of the catalyst were also detected in products CO and CO2 during OCM. CO2 was produced on the catalyst rather than in the gas phase. Oxygen present in 2-La2O2CO3 was capable of activating methane. Amounts of coupling products following a He/CH4 pulse were equivalent to 2 percent of those for a He/CH4/O2 feed pulse. DOE

N93-23027# Sandia National Labs., Albuquerque, NM.
SANDIA COMBUSTION RESEARCH TECHNICAL REVIEW, 1992
R. H. Tucker, ed. and L. R. Cox, ed. 1992 217 p
(Contract DE-AC04-76DR-00789)
(DE93-006399; SAND-92-8224) Avail: CASI HC A10/MF A03

The 77 brief articles contained in this report reflect the ongoing research at Sandia's Combustion Research Facility. They are grouped under: combustion diagnostics (15), combustion chemistry (17), reacting flows (10), combustion in engines and furnaces (15), coal combustion (10), industrial processing (10). Technology partnerships with industry and visiting researcher program are also discussed. Indexes are provided for publications and authors. The articles are processed separately for the data base. DOE

N93-23051# Los Alamos National Lab., NM.
FLUID DENSITY AND CONCENTRATION MEASUREMENT USING NONINVASIVE IN SITU ULTRASONIC RESONANCE INTERFEROMETRY
N. G. Pope, D. K. Veirs, T. N. Claytor, and M. B. Histand (Colorado State Univ., Fort Collins.) 1992 5 p Presented at the IEEE Symposium on Ultrasonics, Tucson, AZ, 20-23 Oct. 1992
(Contract W-7405-eng-36)
(DE93-003741; LA-UR-92-3309; CONF-9210241-1) Avail: CASI HC A01/MF A01

A method of noninvasively measuring the density of fluids contained within pipes, cans, tanks, and bottles was developed. The container-fluid system is interrogated using an ultrasonic transducer. A second transducer is used to observe transmitted energy as the input frequency is swept through an appropriate range determined by the geometry. Resonance peaks are observed in the transmitted energy. The periodicity of the resonant peaks is determined by analyzing the response data using a fast Fourier transform. The technique was tested using known NaCl concentration standards within a stainless steel pipe. The concentration of unknown NaCl solutions were then measured in situ with an accuracy of plus or minus 0.15 M over a range of 0.4 to 3.4 M corresponding to an accuracy of plus or minus 0.02 specific gravity (SG) units over a range of 1.000 to 1.134 SG units. The precision of each measurement ranged from 1 part in 10,000 to 1 part in 1000. Changes in temperature shift the period in a manner similar to shifts from concentration changes; for NaCl solutions the temperature effect can be expressed as an equivalent concentration change and was found to be 0.029 M per C or 0.59 percent over the concentration range measured. Data collection time for a single measurement was less than 2 seconds. DOE

N93-23098# Tecogen, Inc., Waltham, MA.
LIFE CYCLE TESTING OF DESICCANT CORE SAMPLES Final Report, Oct. 1990 - Dec. 1991
B. M. Cohen, S. Neoh, and M. Ross Oct. 1992 95 p Sponsored by Gas Research Institute, Chicago, IL
(Contract GRI-5090-246-2070)
(PB93-127058; GRI-92/0455) Avail: CASI HC A05/MF A01

Several types of desiccant wheels are being used by domestic manufacturers of desiccant dehumidification and cooling equipment. Also, new desiccant cores are under development at GRI. There has been no data base regarding the long-term durability of such wheels. Tecogen had previously measured the performance of new core materials and reported on that work in an earlier report. The work involved subjecting the wheel core samples to extended thermal and moisture cycling in order to determine their ability to retain their characteristics over extended periods of operation. The core samples fell into three categories: lithium chloride, silica gel, and molecular sieve. The molecular sieve cores showed the least degradation, but the regeneration temperature was really too low for the desiccant and that may have contributed to their durability. Lithium chloride cores experienced degradation in total water absorbed, to different degrees, but retained performance, possibly because they characteristically begin with very high levels of moisture uptake. Silica gel wheels degraded significantly

in water uptake and also in performance, probably because they have less excess capacity than lithium chloride cores. Where degradation was high, in practice, an increase in wheel rotational speed can partially offset the performance degradation. GRA

N93-23117# Laval Univ. (Quebec). Combustion Lab.
THE COMBUSTION OF DROPLETS WITHIN GAS TURBINE COMBUSTORS: SOME RECENT OBSERVATIONS ON COMBUSTION EFFICIENCY
J. Odgers, D. Kretschmer, and G. F. Pearce (Aeronautical Research Labs., Melbourne, Australia.) Feb. 1991 68 p
(PERD-JO-194; CTN-93-60698) Avail: CASI HC A04/MF A01

Gas turbine combustors usually employ liquid fuels injected as a spray of small droplets, which are then considered to vaporize and to burn as a vapor/air diffusion flame. The effects of droplet size on combustion efficiency in such combustors were examined through a review of the literature and experiments in scaled combustors. An examination of fuel evaporation/combustion rate equations, residence times available in combustors, and turbulent flame phenomena seems to indicate that either diffusion processes or droplet evaporation would limit the combustion. The times for the latter two processes seem to be too long to be in accord with the available times within practical combustion systems. In experimental studies on two combustors of widely different geometries and fuel systems, a series of correlations was developed to describe their combustion efficiency performance. A significant loss in correlation accuracy is noted when droplet size is included. The experimental results also showed that under steady state conditions, when droplet size was varied by changing the fuel atomizer, there was no noticeable effect on combustion efficiency attributable to the variation in droplet size. It is recognized that droplet size may be of importance in unsteady conditions and in other possible conditions not investigated in the experiments. CISTI

N93-23181 Maryland Univ., College Park.
TRANSIENT RADIATION PROPERTIES OF STRONGLY RADIATING TURBULENT FLAMES Ph.D. Thesis
Jer-Huan Jang 1992 188 p
Avail: Univ. Microfilms Order No. DA9234583

A theoretical and experimental study of transient radiation properties of strongly radiating turbulent diffusion flames is described with emphasis on understanding the temporal variations in radiative heat loss fractions. The theoretical analysis includes the numerical integration of enthalpy equation in time to calculate transient properties of strongly radiating flames and time series to simulate radiation interaction with turbulence. A new approach, Eulerian-Lagrangian method, has been used to find the transient properties of strongly radiating turbulent flames. Simultaneous transient measurements of temperature, soot volume fraction (emission and absorption), and carbon dioxide concentration have been obtained using a five wavelength intrusive absorption/emission probe. The five line optical diagnostic technique was used for the first time to measure transient soot volume fractions, temperature and carbon dioxide concentrations simultaneously in strongly radiating turbulent flames. The results of this research give us an improved understanding of the radiation heat loss mechanism in strongly radiating turbulent flames. Existing intrusive optical probes has been developed further to yield five channels of information. Data concerning local instantaneous radiative heat loss fraction have been obtained and not only serve to evaluate the results of the analysis but also aid in the development and evaluation of more rigorous treatments. The contributions of this research are (1) unique structure has been discovered for strongly radiating flames; (2) significant advancement of intrusive optical diagnostics technology has been applied; and (3) large amount of cold soot has been observed. Dissert. Abstr.

N93-23274# Florida Univ., Gainesville. Dept. of Chemistry.
ACOUSTIC DETERMINATION OF DEWPOINTS IN NATURAL GAS MIXTURES AND RETROGRADE CONDENSATES Annual Report, Jan. - Dec. 1989
S. O. Colgate Feb. 1992 181 p Sponsored by Gas Research Inst., Chicago, IL
(PB93-142917; GRI-92/0355) Avail: CASI HC A09/MF A02

The sonic speed is utilized as a sensitive probe for detecting phase boundaries and critical points of fluids. Location of the boundary is revealed by a discontinuity in the variation of sonic speed with temperature for a sample confined isochorically in a spherical acoustic resonator. The corresponding temperature at which this discontinuity occurs was taken as a phase boundary temperature. This indicator is very pronounced, especially when the system is near the critical condition for which strong local density fluctuations disperse sound and cause the sonic speed to dip sharply toward zero. This research reports on such studies for two pure gases CO2, and C2H6 and one mixture of these two. For each system, data on resonance frequency, amplitude, and pressure as a function of temperature were collected under computer control for a series of different loading densities around the critical value. Portions of the phase diagrams revealed by the measurements were recorded in tabular and graphical formats. GRA

N93-23309# Pennsylvania State Univ., University Park.
STUDIES OF THE FORMATION CHEMICAL REACTIVITY AND PROPERTIES OF SMALL CLUSTERS APPLICATION TO AN UNDERSTANDING OF AEROSOL FORMATION AND HETEROGENEOUS CHEMISTRY
A. W. Castleman, Jr. 1992 18 p
(Contract DE-FG02-88ER-60648)
(DE93-005920; DOE/ER-60648/5) Avail: CASI HC A03/MF A01

Chemical reactions that proceed following either a photophysical or ionizing event, are directly influenced by the mechanisms of energy transfer and dissipation away from the primary site of absorption. Neighboring solvent or solute molecules can affect this by collisional deactivation (removal of energy), through effects in which dissociating molecules are kept in relatively close proximity for comparatively long periods of time due to the presence of the solvent, and in other ways where the solvent influences the energetics of the reaction coordinate. Research on clusters offers one of the most viable ways of elucidating the molecular details of these processes. The current program is comprised of three general areas of research. Investigation of the dynamics of ionization and the mechanisms of the early-time reactions following the interaction of ionizing electromagnetic radiation with matter; measurement of the kinetics of ensuing ion reactions with effort focused on the influence of solvation effects and identifying similarities and differences between gas and condensed phase reactions; and determination of the structure of solvated reaction centers via spectroscopy, dynamics and thermochemistry. DOE

N93-23340# Stanford Univ., CA. High Temperature Gasdynamics Lab.
SPECTROSCOPY AND KINETICS OF COMBUSTION GASES AT HIGH TEMPERATURES
R. K. Hanson and C. T. Bowman Nov. 1992 5 p
(Contract DE-FG03-88ER-13857)
(DE93-006892; DOE/ER-13857/T3) Avail: CASI HC A01/MF A01

This program involves two complementary activities: (1) development and application of cw ring dye laser absorption methods for sensitive detection of radical species and measurement of fundamental spectroscopic parameters at high temperatures; and (2) shock tube studies of radical-molecule and radical-radical reactions relevant to combustion. Species currently under investigation in the spectroscopic portion of the research include NO and CH3; this has necessitated the development of a unique intracavity frequency-doubling system for our cw laser which operates at wavelengths in the range 210-230 nm. Shock tube studies of reaction kinetics currently are focussed on reactions of CH3 radicals. DOE

N93-23341# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
THEORETICAL STUDY OF REACTIONS AT THE ELECTRODE-ELECTROLYTE INTERFACE
J. W. Halley 1993 6 p
(Contract DE-FG02-91ER-45455)
(DE93-006899; DOE/ER-45455/1) Avail: CASI HC A02/MF A01

Electron transfer rates are predicted by numerical methods in a collaboration with Argonne National Laboratory. Emphasis is on electron transfer involving ions known to be important in enhancing stress corrosion cracking in light water reactors and on electron transfer at oxide surfaces. We have produced a new theory for description of the Jahn Teller effect in the solvation shell of the cuprous ion in aqueous solution, have implemented it in a molecular dynamics simulation, and compared the results with experimental neutron scattering measurements on solutions containing the cuprous ion. A large amount of numerical data was collected

on the transition state of the ferrous ferric electron transfer reaction at an electrode. Work was completed on a polarizable and dissociable model of water for use in the electron transfer studies. New calculations of the conductivity in models of oxides have shown the existence of impurity conduction bands in such models for the first time. DOE

N93-23347# Stanford Univ., CA. High Temperature Gas Dynamics Lab.
INVESTIGATION OF CRITICAL C/H/N/O REACTIONS IN NOx FORMATION AND REMOVAL IN NATURAL GAS COMBUSTION Final Report, Jul. 1986 - Aug. 1992
R. K. Hanson and C. T. Bowman Aug. 1992 28 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5086-260-1248)
(PB93-132702; GRI-92/0429) Avail: CASI HC A03/MF A01

The kinetics of reactions important in the formation and removal of NO in the combustion of natural gas were investigated using a shock tube. Detection of key reactant and product species was accomplished by various optical techniques, including atomic resonance absorption for measurement of atomic species and narrowline laser absorption for detection of molecular species. In some experiments, both thermal pyrolysis and laser photolysis techniques were used to initiate reaction, thereby extending the temperature range for which data could be obtained. Development of a comprehensive reaction mechanism for natural gas combustion and NO formation has been initiated in collaboration with other Gas Research Institute (GRI) researchers. Kinetic data from the present shock tube study have been included in the mechanism. GRA

N93-23481# Massachusetts Inst. of Tech., Cambridge.
VORTEX SIMULATION OF TURBULENT COMBUSTION Final Report, Sep. 1989 - Aug. 1992
Ahmed F. Ghoniem 19 Nov. 1992 132 p
(Grant AF-AFOSR-0491-89)
(AD-A259745; AFOSR-92-1018TR) Avail: CASI HC A07/MF A02

During the course of this work, we focused on the extension of the vortex method and the transport element method to three-dimensional flows and to reacting flow with finite heat release, density variation and volumetric expansion. Problems explored in detail include the formation of streamwise vorticity in uniform-density and variable density flow, the effect of this vorticity on the rate of product formation and the effect of volumetric expansion due to heat release on shear layer growth rate. GRA

N93-23658# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
COMPARISON OF DIFFERENT SYNTHETIC ROUTES FOR SULFONATION OF POLYANILINE Technical Report, 31 May 1991 - 30 Jun. 1992
J. Yue, G. Gordon, and A. J. Epstein 29 Jun. 1992 33 p
(Contract N00014-90-J-1559)
(AD-A259662; Rept-1992-48) Avail: CASI HC A03/MF A01

Polyanilines containing sulfonic groups covalently bonded to the back were synthesized from parent polyaniline via sulfonation of the polymer utilizing differing sulfonation agents and differing means. The sulfonation conditions were studied as a function of several parameters including sulfonation time, starting forms of the precursor polymer, presence of oxidizer, ((NH4)2S2O8), and temperature. The sulfonated polyanilines were characterized by FTIR, elemental analyses, DC conductivity, and electrochemical methods. It was found that using fuming sulfuric acid as the sulfonation agent gave both higher conductivity and higher sulfonation level for sulfonated polyaniline than implementation of other sulfonation agents and means. GRA

N93-23963# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
ELECTRONIC CONTROL OF pH AT SULFONATED POLYANILINE ELECTRODES Technical Report, 31 May 1991 - 30 Jun. 1992
J. Yue and A. J. Epstein 1 Jul. 1992 12 p
(Contract N00014-90-J-1559)
(AD-A260074; TR-1992-49) Avail: CASI HC A03/MF A01

The pH of aqueous solutions in the vicinity of a thin self-doped conducting polyaniline electrode was electrochemically modulated using both cyclic voltammetry and step potential techniques. Changes in pH were measured directly by using a microcombination pH probe. The experimental results demonstrate that the polymer behaves as a proton ejector during oxidation and a proton absorber during reduction. This potential-controlled pH change near the polymer coated electrode may be applied to many fields benefitting from electronic control of the proton environment near an electrode surface, for example, control of enzyme activity. GRA

N93-23994# Eltron Research, Inc., Boulder, CO.
METHANE CONVERSION BY SOLID ELECTROLYTE MEMBRANES Annual Report, 1 Jan. 1990 - 31 Aug. 1992
Anthony F. Sammells, Michael Schwartz, Ronald L. Cook, and James H. White Sep. 1992 89 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5089-260-1824)
(PB93-127041; GRI-92/0441) Avail: CASI HC A05/MF A01

The program is focussing on solid-state fuel cells which operate in the same temperature range as molten carbonate fuel cells. One approach involves selecting new solid electrolytes with high ionic conductivity at around 600 C. Experimentally determined activation energies for ionic transport in perovskite solid electrolytes were found related to lattice and thermodynamic parameters. Using the approach, solid electrolytes having high ionic and low electronic conductivity were identified. These electrolytes were incorporated in small unoptimized laboratory fuel cells that may perform better at 600 C than zirconia based SOFC's at 1000 C, assuming that many other issues can be resolved. These issues include the chemical and physical stability of cell components, including electrocatalysts for each respective half-cell reaction and the development of multicell designs and fabrication procedures. Progress was made in identifying anode electrocatalysis towards promoting partial and complete CH4 oxidation. New fuel cell structures are being defined using thin-film techniques involving metalloorganic chemical vapor deposition (MOCVD) of solid electrolytes. Author (revised)

N93-24115# Utah Univ., Salt Lake City. Center for Micro Analysis and Reaction Chemistry.
THE DESIGN AND CONSTRUCTION OF AN ION TRAP BASED SYSTEM FOR LASER PYROLYSIS/MASS SPECTROMETRY OF SINGLE ORGANIC AEROSOL PARTICLES Technical Report, 1 Aug. 1991 - 31 Jul. 1992
Henk L. Meuzelaar, Paul A. Cole, Neil S. Arnold, and George Hars Oct. 1992 15 p
(Contract DAAL03-91-G-0296)
(AD-A260455; ARO-29332.1-LS) Avail: CASI HC A03/MF A01

The development of particle introduction techniques to support a three year program for analysis of single bacteria via laser pyrolysis/mass spectrometry is described. Results of an investigation into various sample introduction techniques are discussed including the highly successful quasi-electrospray introduction method using a suspension of particles in methanol. Particles from 0.9 to 13 microns were levitated at pressures down to 10(exp -7) torr, and mass spectrometry pressures of 10(exp -3) torr were obtained in less than 10 min from particle. The effectiveness of these techniques for particle introduction, pump down, and stabilization exceeded the authors expectations and gives a positive prognosis for efforts to perform initial laser pyrolysis/mass spectrometry experiments in the year two effort. GRA

N93-24143# Cornell Univ., Ithaca, NY. School of Chemical Engineering.
EXPERIMENTAL AND THEORETICAL STUDIES OF REVERSE MICELLES IN DENSE GASES Final Report, Oct. 1989 - Oct. 1992
Bernard A. Kraus and Athanassios Panagiotopoulos 10 Nov. 1992 36 p Presented at the AIChE Convention, Los Angeles, CA, Nov. 1991, and Miami Beach, FL, Nov. 1992 Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5089-260-1873)
(PB93-141901; GRI-92/0446) Avail: CASI HC A03/MF A01

Dense gas micellar systems possess a number of unique properties which make them potentially attractive for use in separation processes. This project aims at determining if such applications are viable by examining the relationship between aggregate or micelle size and pressure and the addition of salt. Our work has shown that both pressure and the addition of salt drastically affect the formation of surfactant aggregates in light hydrocarbon-water mixtures. Increases in pressure produce corresponding increases in the hydrocarbon density which dramatically improves the solubility of surfactant in the hydrocarbon phase and causes the formation of more surfactant aggregates. The addition of salt changes the behavior

in two ways. The presence of salt lowers the pressure required to begin the formation of aggregates. Also as salt concentration is increased, the aggregates shrink in size. We have also observed that mixtures of light hydrocarbons are more effective solvents for surfactant than any individual light hydrocarbons. GRA

N93-24155# York Univ. (Ontario). Dept. of Chemistry.
THE GROUND AND EXCITED STATE ELECTRONIC STRUCTURES OF RUTHENIUM QUINONES AND RELATED SPECIES Technical Report, Jun. 1991 - Jul. 1992
A. B. Lever, H. Masui, R. A. Metcalfe, D. J. Stufkens, and E. S. Dodsworth 25 Jan. 1993 23 p
(Contract N00014-91-J-1910)
(AD-A259940; TR-50) Avail: CASI HC A03/MF A01

Electronic and resonance Raman spectroscopy are used to probe the electronic structures of bipyridine ruthenium complexes of quinone and a series of derivatives in which the oxygen atoms of quinone are successively replaced by NH. The electronic structures of some benzoquinonediimine species are probed by variation of substituent in the benzene ring, and the properties of a diaminophenyl substituted benzoquinonediimine are explored as a function of the twist at the 1,1'-link. GRA

N93-24210# Pennsylvania State Univ., University Park. Materials Research Lab.
HIGH PERFORMANCE NANOCOMPOSITE DESICCATION MATERIALS Topical Report, Mar. 1990 - Jun. 1992
Sridhar Komarneni, Prakash B. Malla, and Rustum Roy Jul. 1992 93 p
Sponsored by Gas Research Institute, Chicago, IL
(Contract GRI-5087-260-1473)
(PB93-127025; GRI-92/0438) Avail: CASI HC A05/MF A01

The objective of the research was to tailer-make high performance nanocomposite desiccant materials consisting of clays, gels, and zeolites for gas-fired dehumidification and cooling system applications. Synthetic zeolite Na-Y was modified and its water sorption properties were studied. The modified products exhibited ideal isotherm shape (separation factor between 0.07 and 0.1) and are highly crystalline with high thermal and hydrothermal stability, long regenerative life, and high sorption capacity (less than 30 percent by weight). Many aluminosilicate zeolites having different silicon to aluminum ratio and structures were synthesized with or without templates. Some of these materials exhibited ideal isotherm shapes with about 16-33 percent (by weight) sorption capacity. Aluminophosphate (AlPO4) and silicoalumino-phosphate (SAPO) molecular sieves of varying pore sizes were synthesized and their stability and water sorption properties were studied. One of the SAPO's exhibited close to ideal water sorption isotherm with 40 percent (by weight) sorption capacity although many of these materials exhibited nonideal isotherm shapes due to nonpolar or only slightly polar nature of their pore surfaces. A chemical method involving methanoic HCl was used to remove occluded organic molecules from AlPO4 and SAPO molecular sieves. The method was found to be effective so long as there is no steric hindrance for the methanolic HCl to enter and/or the template molecules to diffuse out of the molecular sieve channels and cages. The method of removal of organic molecules was also found to be effective in stablizing SAPO-37 against water vapor. Author

N93-24212 Virginia Univ., Charlottesville.
EXPERIMENTAL AND NUMERICAL INVESTIGATION OF HYDROGEN COMBUSTION IN A SUPERSONIC FLOW Ph.D. Thesis
Corin Segal 1991 174 p
Avail: Univ. Microfilms Order No. DA9237650

Supersonic combustion ramjet, or SCRAMJET, engines are currently being evaluated for the propulsion of hypersonic vehicles. A unique supersonic wind tunnel facility has been built at the Aerospace Research Laboratory to simulate the operation of a SCRAMJET over a range of Mach numbers of 5 to 6.5 and altitudes of 40,000 to 150,000 ft. The tunnel provides high stagnation temperature, clean air in a continuous Mach 2 flow to the combustor where hydrogen is injected and burned. One of the major parameters in the design of the engine is the combustion efficiency, a quantity which is extremely difficult to evaluate directly. Wall pressure and temperature measurements were made on a model combustor in the ARL facility and a one-dimensional, chemical equilibrium, finite difference model was used to infer combustion efficiency. The initial stagnation temperature was maintained around or below 850 K and an inlet static pressure of 1/2 atm, or less. At these relative low temperatures, thermal choking occurred for relatively low equivalence ratios, limiting this parameter to a maximum of 0.1, depending on the injection configuration. A detailed validation of the analytical model requires extensive knowledge of the physical properties of the flowfield. Since reliable, non-intrusive measurements methods are still under development, the results of the combustion efficiency evaluation were compared with a detailed numerical simulation of the flowfield of interest. The numerical simulation used a 3-D full Navier-Stokes program, which includes a finite rate chemistry model to duplicate one of the experimental cases. The calculations were performed on a CRAY - 2S supercomputer at the National Supercomputer Applications Center at NASA Langley. The solution required 35 CPU hours. The comparison between the 3-D computation and the 1-D calculation indicated a good agreement of the flowfield fluid dynamic properties, but predicted large differences in combustion efficiency. Dissert. Abstr.

N93-24235# Puerto Rico Univ., Rio Piedras. Dept. of Physics.
PHASE TRANSITIONS AT THE FLUID-SOLID INTERFACE IN A MODEL FOR THE ADSORPTION OF HARD SPHERES
Dale A Huckaby and Lesser Blum 15 Jan. 1993 26 p
(Contract N00014-90-J-1263)
(AD-A260304; TR-20) Avail: CASI HC A03/MF A01

Phase transitions at the fluid-solid interface are studied using an adsorption model consisting of a fluid of hard spheres in contact with a planar wall which contains a lattice of sticky adsorption sites. The model is equivalent to a lattice gas with n-body interactions that are related to the n-body correlation functions of the fluid. GRA

N93-24236# Puerto Rico Univ., Rio Piedras. Dept. of Physics.
EFFECT OF TRIPLET CORRELATIONS ON THE ADSORPTION OF A DENSE FLUID ONTO A CRYSTALLINE SURFACE
Dale A. Huckaby and L. Blum 15 Jan. 1993 15 p
(Contract N00014-90-J-1263)
(AD-A260306; TR-16) Avail: CASI HC A03/MF A01

The adsorption of a fluid of hard spheres of diameter a onto a planar surface containing a triangular lattice of adsorption sites, spacing sigma, was studied using a model which is equivalent to a lattice gas with n-body interactions that are related to the n-body correlation functions of the fluid. The present paper extends our previous work, which included only pairwise interactions, to also include triplet interactions. We discovered a simple but accurate analytical approximation to the triplet correlation function for three spheres in mutual contact, which, when combined with a Mueller-Hartmann and Zittarz approximation of the critical point in the equivalent lattice gas, yields the estimate P(sub c)(sigma(exp 3)) = 0 .8409 of the fluid density at the critical point of the condensation transition which occurs at the fluid-crystal interface. This estimate, which includes the effects of both pair and triplet correlations in the fluid, is significantly higher than the value p(sub c)(sigma(exp 3)) = 0.6678 obtained if only the effects of pair correlation are included in the calculation. GRA

N93-24264# York Univ. (Ontario). Dept. of Chemistry.
CORRELATIONS BETWEEN THE LIGAND ELECTROCHEMICAL PARAMETER, E(SUB L)(L) AND THE HAMMETT SUBSTITUENT PARAMETER SIGMA Technical Report No. 51, Jun. 1991 - Jul. 1992
Hitoshi Masui and A. B. Lever 25 Jan. 1993 22 p
(Contract N00014-91-J-1910)
(AD-A260299) Avail: CASI HC A03/MF A01

Correlations of the electrochemical parameter, E(sub L)(L) with Hammett and Taft parameters, sigma(sub p), sigma(sub m), sigma(sup +), and sigma(sup °) are presented and discussed. The correlations provide a means to extend the electrochemical parameter and the Hammett and Taft databases. Recently, a ligand electrochemical parameter, E(sub L)(L), based upon the Ruthenium(3)/2 reduction potential as an electrochemical standard, was introduced and developed. This parameter allows one to predict the metal-centered redox potential of a variety of complexes based on the additivity of the E(sub L)(L) parameters. GRA

N93-24278# Idaho Univ., Moscow. Dept. of Physics.
LASER SPECTROSCOPY OF STIMULATED SCATTERING IN COLLISIONALLY BROADENED GROUP 2A METAL VAPORS Final Report, 1 Oct. 1988 - 1 Apr. 1992
Jim Kelly Nov. 1992 54 p

(Contract F29601-88-C-0024)
(AD-A260532; AD-E201367; PL-TR-92-1040) Avail: CASI HC A04/MF A01

This study is concerned with the development of efficient nonlinear materials which can generate 3-5 microns infrared (IR). Work involved the use of Ca and Sr metal vapors as electronic Raman scattering (SRS). This involved the development of narrow bandwidth pulse lasers, scattering cells, high speed IR detectors, and suitable experimental diagnostics to study the gain for SRS and its temporal development. It was found that SRS never generated, but instead, a variety of other nonlinear responses were readily induced, the most notable being superfluorescence (SF). Results of these studies of SF in the optically trapped principal resonance state of Ca(Sr) may be useful in the development or diagnostics of plasma based x-ray lasers. GRA

N93-24314# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering.
VOLTAMMETRIC CHARACTERIZATION OF SOLUBLE POLYACETYLENE DERIVATIVES OBTAINED FROM THE RING-OPENING METATHESIS POLYMERIZATION (ROMP) OF SUBSTITUTED CYCLOOCTATETRAENES Technical Report, 1 Jan. - 31 Dec. 1992
Thomas H. Jozefiak, Eric J. Ginsburg, Christopher B. Gorman, Robert H. Grubbs, and Nathan S. Lewis 15 Jan. 1993 46 p
(Contract N00014-91-J-1303)
(AD-A260071; TR-2) Avail: CASI HC A03/MF A01

High molecular weight, amorphous, partially substituted polyacetylenes (poly-RCOT) have been prepared using the ring-opening metathesis polymerization of substituted cyclooctetraenes. Spin-cast films of these polymers yielded unusually sharp, well-defined reversible electrochemistry for oxidative and reductive doping processes. As the substituent on the polymer chain was varied (R = alkyl, tert-butoxy, trimethylsilyl, and p-X-phenyl), the potentials for oxidative and reductive doping changed by 0.3 V. In addition, the separation between the oxidative and reductive doping processes varied from 1.66 V to greater than 2.0 V. Coulometry suggested that the reversible doping step represented a transfer of 1 electron for every 13-15 double bonds of the polymer. In contrast, the electrochemistry of predominantly- cis poly-RCOT films was irreversible, and indicated the presence of an electrochemical cis-trans isomerization on the first voltammetric sweep through either reductive or oxidative doping. Spectroelectrochemical studies indicated that the electrochemically doped poly-RCOT materials R=sec-butyl, (CH3)3Si) possessed mid-gap transitions at energies of 0.8-0.9 eV. The redox chemistry of the soluble, poly-RCOT (R=sec-butyl, (CH3)3Si) species in CH2Cl2 solution was also investigated. Voltammetric studies showed that both the reductive and oxidative doping processes were chemically irreversible, and indicated that the dissolved polymers were electroactive over a wide range of potentials. GRA

N93-24333# Dayton Univ. Research Inst., OH.
COMBUSTION AND HEAT TRANSFER STUDIES UTILIZING ADVANCED DIAGNOSTICS: COMBUSTION STUDIES Final Report, 11 Sep. 1987 - 30 Sep. 1992
D. R. Ballal, S. P. Heneghan, W. J. Schmoll, F. Takahasi, and M. D. Vangsness Nov. 1992 214 p
(Contract F33615-87-C-2767)
(AD-A260253; WL-TR-92-2110) Avail: CASI HC A10/MF A03

A long-term goal of the Air Force is to develop near-stoichiometric gas turbine combustors that will burn broad-specification fuels, and have low maintenance and high durability. Towards meeting this goal, this program had two principal objectives: to design and conduct experiments that will establish a fundamental understanding of lean blowout (LBO), swirling flames, kinetically controlled combustion, and turbine blade cooling, and to provide data sets for evaluating and refining computer models of gas turbine combustor. We successfully designed and operated several laboratory combustors. Two novel methods for CARS slit function were developed; these made possible precise and unambiguous measurements of flame temperature. We identified the complex sequence of events leading to LBO and obtained and analyzed LBO data for different combustor loadings. We investigated the effects of geometric, chemical, and turbulent flow parameters on the structure of the recirculation zone and the flame inside the combustor. Our heat transfer experiments showed that freestream turbulence augments flat plate heat transfer 2 to 2.5 times. Finally, benchmark-quality data for evaluating and refining computer models of gas turbine combustor were made available to industry. In this manner, the program objectives were met.... Lean blowout, Flame stabilization, Combustor design, Swirling flames, Turbulent combustion, Turbine blade cooling. GRA

N93-24414# Howard Univ., Washington, DC.
LASER EXCITATION AND CHEMI-IONIZATION OF COMBUSTION SPECIES Final Report, 1 Sep. 1989 - 31 Aug. 1992
Vikram S. Kushawaha 15 Oct. 1992 3 p
(Contract DAAL03-89-G-0099)
(AD-A260120; ARO-27030.11-CH-SAH) Avail: CASI HC A01/MF A01

During the tenure of the project, we have studied the ion-molecule reactions involving collisions of low energy CHO(+) ions and CH4, H2, N2, O2, etc. molecules. Several electronically excited states have been identified and the reaction rate coefficients have been measured for the strongest band(s) of the excited state molecules or radicals and the atomic lines. We have also extensively studied the Stimulated Raman scattering processes in a wide and capillary tubings and have measured the efficiency of scattered laser lines at various wavelengths in CH4 and H2 as gain media. These experiments were performed at high pressures of these gases (100 - 500 psi) and high pump energy (1-100 mJ) of the third harmonic of the Nd:YAG laser. Our results indicate that the capillary tubing is slightly more efficient that the wide bore tubing and a compact Raman laser source may be built for scientific research. In addition, we have studied the competition between the stimulated Raman and Brillouin scattering processes and calculated the corresponding gain coefficients. During the studies of the scattering processes, we have observed the two photon excitation and dissociation of CH4 and H2 molecules using the third harmonic pulsed laser line at 355 run from Nd:YAG. The photodissociative excitation of CH-radicals and H-atomic lines may be used for diagnostic purposes of the unburnt methane and hydrogen gases in combustion flame. GRA

N93-24422# Project Sunrise, Inc., Brookline, MA.
PHOTOPROMOTED AND THERMAL DECOMPOSITION OF NITRIC OXIDE BY METAL OXIDES Final Report, 12 Jun. 1989 - 30 Jun. 1991
E. Berman, J. Dong, and Norman N. Lichtin Apr. 1992 40 p
(Contract F08635-89-C-0225)
(AD-A259766; AFESC/ESL-TR-91-32) Avail: CASI HC A03/MF A01

This technical report summarizes research on decomposition of NO(x) by photopromoted and thermal solid-catalyzed decomposition of NO. Typical catalysts incorporated one or more metal oxides. Photopromotion of catalytic activity was observed with several catalysts. Nearly complete thermal decomposition of NO was achieved by several catalysts in the absence of O2. However, no combination of catalyst and conditions achieved satisfactory rates of decomposition of NO in the presence of target concentrations (greater than 10 percent) of O2. GRA

N93-24423# Naval Research Lab., Washington, DC. Lab. for Computational Physics and Fluid Dynamics.
NUMERICAL STUDIES FOR THE RAM ACCELERATOR Final Report, 1 Jan. 1990 - 30 Sep. 1992
Elaine S. Oran, Chiping Li, and K. Kailasanath 23 Dec. 1992 19 p
(AD-A259949; AFOSR-93-0020TR) Avail: CASI HC A03/MF A01

Time-dependent, multidimensional computations were performed to study basic issues related to the structure of shocks, detonations, and modes of combustion affecting the feasibility or performance of the ram accelerator. A focus was on understanding of the structure and stability of oblique detonations generated by oblique shocks in supersonic fuel-air mixtures. The simulations show that steady, oblique detonations can be stabilized in supersonic flows and that they have very complex, multidimensional structures. Basic elements of such detonation structure include the following: (1) a nonreactive, oblique shock, (2) an induction zone, (3) a set of deflagration waves, and (4) a reactive shock in which the shock front is closely coupled with the energy release. This structure is stable and resilient to disturbances in the flow in a wide range of flow and mixture conditions. The conditions under which the overall detonation structure becomes unstable were also identified. Preliminary studies which compared extremely resolved Navier-Stokes simulations to a boundary-layer model indicate some fundamental disagreements between the model and the simulations which require further investigations to resolve. GRA

N93-24429# University of Northern Illinois, De Kalb. Dept. of Chemistry.
CHARGE TRANSFER PROCESSES ON LIQUID/LIQUID INTERFACES: THE FIRST HUNDRED YEARS
Petr Vanysek 31 Dec. 1992 17 p
(Contract N00014-91-J-1058)
(AD-A260421; TR-048) Avail: CASI HC A03/MF A01

Electrochemistry dealing with interfaces between two immiscible and ionically conductive solutions (ITIES) has been documented in literature already a hundred years ago. The work has only recently attracted a wider attention. The trends in experimental electrochemistry, optical studies of the interface, and recently emerging theoretical work are reviewed. Currently about 100 publications appear per year. GRA

N93-24472*# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.
AN EXTENDED SUPERSONIC COMBUSTION MODEL FOR THE DYNAMIC ANALYSIS OF HYPERSONIC VEHICLES Interim Task Report
J. A. Bossard, R. E. Peck, and D. K. Schmidt Mar. 1993 31 p
(Grant NAG1-1341)
(NASA-CR-192716; NAS 1.26:192716; ARC-93-2) Avail: CASI HC A03/MF A01

The development of an advanced dynamic model for aeroelastic hypersonic vehicles powered by air breathing engines requires an adequate engine model. This report provides a discussion of some of the more important features of supersonic combustion and their relevance to the analysis and design of supersonic ramjet engines. Of particular interest are those aspects of combustion that impact the control of the process. Furthermore, the report summarizes efforts to enhance the aeropropulsive/aeroelastic dynamic model developed at the Aerospace Research Center of Arizona State University by focusing on combustion and improved modeling of this flow. The expanded supersonic combustor model described here has the capability to model the effects of friction, area change, and mass addition, in addition to the heat addition process. A comparison is made of the results from four cases: (1) heat addition only; (2) heat addition plus friction; (3) heat addition, friction, and area reduction, and (4) heat addition, friction, area reduction, and mass addition. The relative impact of these effects on the Mach number, static temperature, and static pressure distributions within the combustor are then shown. Finally, the effects of frozen versus equilibrium flow conditions within the exhaust plume is discussed. Author (revised)

N93-24498# Aluminum Co. of America, Pittsburgh, PA.
GAS SEPARATIONS USING CERAMIC MEMBRANES
P. K. T. Liu, C. L. Lin, D. L. Flowers, J. C. S. Wu, and G. W. Smith 1992 15 p Presented at the US DOE Contractors Review Meeting on Gasification and Gas Stream Cleanup Systems, Morgantown, WV, 15-17 Sep. 1992
(Contract DE-AC21-88MC-25135)
(DE93-003204; DOE/MC-25135/93/C0101; CONF-920951-47) Avail: CASI HC A03/MF A01

Alcoa's commercial membrane with 40 A pore diameter has been identified as one of the potential candidates for high temperature gas separations. This asymmetric multiple layer membrane has been well characterized and evaluated. It has excellent thermal stability and acceptably hydrothermal stability at approximately 650 C or above. Gas separations with this membrane follow Knudsen diffusion. Its selectivity is suitable for bulk separations, or for reduction/elimination of H2S and NH3 via selective removal of hydrogen. An improved separation efficiency with this membrane is highly desirable for applications involving hydrogen separation, and the removal of trace contaminants, such as H2S and NH3. One of the effective avenues in improving the efficiency of the existing membrane is to narrow its pore size through surface modifications. Thus membranes with a smaller pore size can be readily available through minor modifications of the existing commercial product. In this paper focus is on the morphological characterization and performance evaluation of hydrogen-selective and zeolitic membranes developed from existing commercial membranes. DOE

N93-24575# Delaware Univ., Newark. Center for Catalytic Science and Technology.
DESIGN OF A HIGH ACTIVITY AND SELECTIVITY ALCOHOL CATALYST
H. C. Foley and G. A. Mills Feb. 1992 16 p
(Contract DE-FG22-90PC-90291)
(DE93-008100; DOE/PC-90291/T7) Avail: CASI HC A03/MF A01

Results of the pyridine adsorption studies on native and K-doped alumina provide fundamental grounding for the observed methanol dehydration activity of these samples. Both the reactor studies and the pyridine adsorption studies support the conclusion that the K-doped sample had reduced Lewis acidity. Moreover, we were able to measurably alter the acidity of the support surface by our ion exchange treatment. More significantly, when reactor results for transition-metal loaded samples are reconsidered in combination with their surface characteristics suggested by our pyridine adsorption studies, our hypothesis that Rh and Mo have ultimately titrated the support surface seems all the more convincing. Hence, in light of the pyridine adsorption results, the attenuation of a transition-metal based decomposition pathway for methanol on the metal-loaded samples-as seen in the reactor testing-is all the more reasonable. DOE

N93-24623# Ecole Centrale de Lyon (France). Lab. de Physicochimie des Interfaces.
SPECTROSCOPIC STUDY OF DIFFERENT PHASES OF THE VPO SYSTEM IN RELATION TO THEIR CATALYTIC PROPERTIES: IN SITU CATALYZER MEASUREMENT BY RAMAN SPECTROSCOPY Ph.D. Thesis [ETUDE SPECTROSCOPIQUE DE DIFFERENTES PHASES DU SYSTEME VPO EN RELATION AVEC LEURS PROPRIETES CATALYTIQUES. SUIVI IN SITU DE CATALYSEURS PAR SPECTROMETRIE RAMAN]
Farid BenAbdelouahab 1991 140 p In FRENCH
(ECL-91-21; ETN-93-93520) Avail: CASI HC A07/MF A02

A study aimed at the characterization of catalyzer phases by Raman spectrometry is presented. Structural data and available spectroscopy for different VPO (Vanadium Phosphorous Oxygen) phases identified in the catalyzers are given. Experimental methods developed, in particular Raman spectrometry coupled with chromatographic analysis, for in situ catalytic reaction analysis are presented. Results, relating to temperature, on the Raman spectra of pure phases, the modifications introduced by hydration, and the phase behavior in reactional medium in catalysis conditions are reported. Structural considerations based on the literature and observations are given. An attempt to give a synthetic image of VOPO4 phases is made. The behavior of the precursor and its activation and transformation as catalyzer are described. ESA

N93-24632# National Inst. of Standards and Technology, Gaithersburg, MD. Semiconductor Electronics Div.
METROLOGIC SUPPORT FOR THE DARPA/NRL-XRL MASK PROGRAM: ELLIPSOMETRIC ANALYSES OF SiC THIN FILMS ON Si Final Report, Aug. 1991 - Mar. 1992
D. Chandler-Horowitz, J. F. Nguyen, J. F. Marchiando, and P. M. Amitharaj Jan. 1993 21 p Sponsored by DARPA
(PB93-152098; NISTIR-4860) Avail: CASI HC A03/MF A01

Ellipsometric analyses were performed on a number of amorphous SiC films grown on Si which are currently being considered for x ray lithography (XRL) mask membranes. The analyses and conclusions presented increase the accuracy with which the layer thicknesses can be determined. In addition, materials-related information such as the presence of surface roughness, Si and graphite phases, as well as densification can be discerned from the data. The sensitivity of ellipsometry to very small changes in the phase of light (equal to or less than 0.002 deg) makes it an extremely accurate optical tool capable of detecting small changes in thickness or optical properties. Samples were measured by single-frequency and spectroscopic ellipsometry. The measurements were analyzed by using a number of models. Three models with increasing degree of complexity and sophistication for the amorphous SiC film are compared: an isotropic one-layer model, an isotropic two-layer model that accommodates a surface layer/region, and a uniaxial one-layer model to account for possible built-in strain in the film. The two layer model was found to give the most consistent fit to the experimental data. GRA

N93-22165*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
ACTIVE HYDRAZINE VAPOR SAMPLER (AHVS)
Rebecca C. Young, Charles F. McBrearty (I-NET, Inc., Cocoa Beach, FL.), and Daniel J. Curran (I-NET, Inc., Cocoa Beach, FL.) *In* NASA, Washington,

Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 153-163 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

N93-22183*# Oak Ridge National Lab., TN.
METHODS FOR PREDICTING PROPERTIES AND TAILORING SALT SOLUTIONS FOR INDUSTRIAL PROCESSES
Moonis R. Ally *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 324-329 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22838# Laboratoire d'Aerothermique du CNRS, Meudon (France).
ACTION OF AN ACCELERATION FIELD ON PREMIXED METHANE/AIR FLAMES [ACTION DU CHAMP D'ACCELERATION SUR LES FLAMMES DE PREMELANGE METHANE/AIR]
R. Prudhomme and D. Durox *In* ESA, Fluids in Space Jun. 1992 p 131-144 In FRENCH (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22839# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Materials and Processes Div.
PRACTICAL PROBLEMS RELATED TO FLAMMABILITY AND COMBUSTION IN SPACE
M. D. Judd *In its* Fluids in Space Jun. 1992 p 145-161 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22840# Laboratoire d'Aerothermique du CNRS, Meudon (France).
INFLUENCE OF GRAVITY ON POLYEDRIC FLAMES [EFFETS DE LA GRAVITE SUR LES FLAMMES POLYEDRALES]
D. Durox *In* ESA, Fluids in Space Jun. 1992 p 163-176 In FRENCH (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22853# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Service de Physique de l'Etat Condense.
PHASE SEPARATION UNDER A WEAK CONCENTRATION GRADIENT
Y. Jayalakshmi, B. Khalil, and D. Beysens *In* ESA, Fluids in Space Jun. 1992 p 389-403 Sponsored by CNES (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22854# Centre National de la Recherche Scientifique, Orleans (France). Lab. de Combustion et Systemes Reactifs.
BURNING CHARACTERISTICS OF n-HEPTANE DROPLETS WITH NEGLIGIBLE BUOYANCY EFFECTS
X. Chesneau, C. Chauveau, and I. Goekalp *In* ESA, Fluids in Space Jun. 1992 p 407-418 Sponsored by ESA and CNRS (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N93-22049# Argonne National Lab., IL.
RECONSTRUCTION OF TWIST GRAIN BOUNDARIES IN GOLD
S. R. Phillpot Nov. 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-004861; ANL/MSD/CP-78164; CONF-921101-21) Avail: CASI HC A02/MF A01

The reconstruction of high-angle twist grain boundaries on the four densest atomic planes in gold are investigated using the recently developed method of grand-canonical simulated quenching. It is found that the grain boundaries on the two densest planes, (111) and (100), do not reconstruct, while those on the (110) and (113) planes do. DOE

N93-22069# Oak Ridge National Lab., TN.
MEASUREMENT OF THE CRITICAL LEVEL OF MOISTURE FOR INITIATION OF WATER-VAPOR-INDUCED ENVIRONMENTAL EMBRITTLEMENT IN A Fe3AL-BASED ALLOY
C. G. McKamey and E. H. Lee 1992 6 p Presented at the Material Research Society Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004104; CONF-921101-10) Avail: CASI HC A02/MF A01

Iron aluminides based on Fe3Al are of interest as structural materials because of their excellent corrosion resistance. However, studies have shown that one of the major causes of low room temperature tensile ductility, which so far has limited the use of these alloys, is an environmental reaction involving aluminum in the presence of water vapor. During this reaction, atomic hydrogen is released, moves into the sample ahead of the crack tip during stressing, and causes failure before the true ultimate tensile strength of the material is reached. This reaction is reduced significantly by testing in oxygen or vacuum. In the present study, an Fe3Al-based alloy was tensile tested as a function of the level of water vapor in the test environment, from a vacuum of 10(exp -4) Pa to a water vapor partial pressure of 1330 Pa. The results show that a water vapor level of as low as 133 Pa (1 torr) can result in significant embrittlement. The fracture mode remains transgranular cleavage, but the scale of the cleavage facets changes with the water vapor level. DOE

N93-22340# Los Alamos National Lab., NM.
PRETRANSFORMATION STRAIN MODULATIONS IN PROPER FERROELASTICS
A. Saxena and G. R. Barsch (Pennsylvania State Univ., University Park.) 1992 19 p Presented at the Center for Nonlinear Studies (CNLS) Conference: Nonlinearity in Materials Science, Los Alamos, NM, May 1992
(Contract W-7405-eng-36)
(DE93-005468; LA-UR-92-4327; CONF-9205229-3) Avail: CASI HC A03/MF A01

Within the framework of the Landau-Ginzburg model for the O(sub h)-D(sub 4h) proper ferroelastic transformation pretransformation structural modulations may arise as (possibly defect-stabilized) pseudo-critical fluctuations that can be described by an effective elastic phi(sub 4) model. Here we show that the strain amplitude and temperature dependence of an intermediate tetragonal phase observed above and concurrently with the face-centered cubic to face-centered tetragonal transition in Fe(0.7)Pd(0.3) can be understood semi-quantitatively in terms of the crossover behavior from the Ising to the displacive limit by applying the crossover phase diagram of Beale, Sarker and Krumhanal to the effective phi(sup 4) model. The fact that this type of pretransformation modulation has not been observed with x-ray for other ferroelastic transformations can be attributed to large values of the order parameter gradient coefficient in these cases. DOE

N93-22345# Argonne National Lab., IL.
GENERALIZED MELTING CRITERION FOR AMORPHIZATION
R. Devanathan (Northwestern Univ., Evanston, IL.), N. Q. Lam, P. R. Okamoto, and M. Meshii (Northwestern Univ., Evanston, IL.) Dec. 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-005557; ANL/MSD/CP-76615; CONF-921101-59) Avail: CASI HC A02/MF A01

We present a thermodynamic model of solid-state amorphization based on a generalization of the well-known Lindemann criterion. The original Lindemann criterion proposes that melting occurs when the root-mean-square amplitude of thermal displacement exceeds a critical value. This criterion can be generalized to include solid-state amorphization by taking into account the static displacements. In an effort to verify the generalized melting

criterion, we have performed molecular dynamics simulations of radiation-induced amorphization in NiZr, NiZr2, NiTi, and FeTi using embedded-atom potentials. The average shear elastic constant G was calculated as a function of the total mean-square atomic displacement following random atom-exchanges and introduction of Frenkel pairs. Results provide strong support for the generalized melting criterion. DOE

N93-22496# Oak Ridge National Lab., TN.
ABLATION, MELTING, AND SMOOTHING OF POLYCRYSTALLINE ALUMINA BY PULSED EXCIMER LASER RADIATION
D. H. Lowndes, D. B. Geohegan, M. DeSilva (Tennessee Univ., Knoxville.), M. J. Godbole (Tennessee Univ., Knoxville.), and A. J. Pedraza (Tennessee Univ., Knoxville.) Nov. 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005148; CONF-921101-26) Avail: CASI HC A02/MF A01

Effects of pulsed XeCl (308 nm) laser radiation on polycrystalline Al2O3 (alumina, 99.6 percent pure) and single-crystal Al2O3 (sapphire) are studied as a function of laser fluence. No laser etching of either material is detected below a threshold fluence value (much lower for alumina than for sapphire). Above this threshold, laser etching of both materials is observed following a number of incubation (induction) pulses. This number is much larger for sapphire than for alumina but decreases with increasing fluence for both materials. Laser etching rates for the two materials are similar at high fluences and after the incubation period. Scanning electron microscope images show that alumina melts and flows under repeated irradiation at fluences (greater than or equal to 0.7 J/cm(exp 2). Atomic force microscopy and surface profilometry reveal significant smoothing of the as-received polycrystalline alumina surface after repeated irradiations at moderate fluences (approximately 1-3 J/cm(exp 2)). Ion probe measurements for alumina in vacuum confirm the incubation behavior, and reveal that at fixed fluence the (positive) charge collected per pulse saturates after a sufficient number of pulses, as does the etch-plume velocity. Results are interpreted in terms of laser-generation of a sufficient concentration of absorption centers before efficient ablation/etching of these wide bandgap materials can occur. DOE

N93-22517# Los Alamos National Lab., NM.
THE SURFACE INTERACTION OF OXYGEN WITH A GAMMA TiAl
T. N. Taylor and M. T. Paffett 1992 11 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-7405-eng-36)
(DE93-003847; LA-UR-92-3815; CONF-921101-3) Avail: CASI HC A03/MF A01

The composition and bonding of incipient and atmospheric oxides grown on a gamma-TiAl (2 at. percent Nb) were examined using Auger, x-ray, and low-energy ion scattering spectroscopies. The depth distribution of various components was determined with secondary-ion mass spectroscopy (SIMS). An oxide grown on the material in air at room temperature showed advanced Al and Ti oxide bonding states, which had very different stabilities during heating in vacuum up to 600 degrees C. The Ti-oxygen bonding state was markedly reduced while the Al oxide was somewhat enhanced during this process. Further controlled studies at 600 degrees C, involving oxygen adsorption below approximately 10(exp -6) Torr, showed an initial Al cation surface enrichment until the detectable Al 2p peak was 90 percent oxidized. Further oxygen exposure gradually produced a fully oxidized Ti valence state with a pronounced enrichment of the Ti cation at the vacuum-solid interface. The results are discussed in terms of the kinetic and thermodynamic factors of the rate-limiting steps in the oxidation process. DOE

N93-22547# Brookhaven National Lab., Upton, NY.
DYNAMICS OF A METAL OVERLAYER ON METALLIC SUBSTRATES: HIGH TEMPERATURE EFFECTS
T. S. Rahman, J. E. Black (Brock Univ., Saint Catherines, Ontario.), and Zeng-Ju Tian (Brock Univ., Saint Catherines, Ontario.) 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC02-76CH-00016)
(DE93-006382; BNL-48336; CONF-921101-68) Avail: CASI HC A02/MF A01

We have explored the structure and the dynamics of a bimetallic system consisting of a hexagonal (almost) overlayer of Ag on a square lattice (Ni(100) and Cu(100)), as a function of the surface temperature. In each case the structure is 'nearly' incommensurate giving rise to a low frequency Goldstone mode. Also, the overlayer atoms slosh back and forth over the substrate in a corrugated fashion. The calculated dispersion of the Ag/metal vertical mode, at room temperature, is in excellent agreement with experimental data. At higher temperatures floater atoms appear on top of the overlayer displaying a variety of cluster formations and also exchanges with the substrate atoms leading to surface disordering, interdiffusion and melting. DOE

N93-22556*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CHARACTERIZATION AND DURABILITY TESTING OF PLASMA-SPRAYED ZIRCONIA-YTTRIA AND HAFNIA-YTTRIA THERMAL BARRIER COATINGS. PART 1: EFFECT OF SPRAY PARAMETERS ON THE PERFORMANCE OF SEVERAL LOTS OF PARTIALLY STABILIZED ZIRCONIA-YTTRIA POWDER
Robert A. Miller, George W. Leissler (Sverdrup Technology, Inc., Brook Park, OH.), and J. Marcus Jobe (Miami Univ., Oxford, OH.) Feb. 1993 34 p
(Contract NAS3-25266; RTOP 505-63-5A)
(NASA-TP-3295; E-7151; NAS 1.60:3295) Avail: CASI HC A03/MF A01

Initial experiments conducted on thermal barrier coatings prepared in the newly upgraded research plasma spray facility and the burner rig test facilities are discussed. Part 1 discusses experiments which establish the spray parameters for three baseline zirconia-yttria coatings. The quality of five similar coating lots was judged primarily by their response to burner rig exposure supplemented by data from other sources such as specimen characterizations and thermal diffusivity measurements. After allowing for burner rig variability, although there appears to be an optimum density (i.e., optimum microstructure) for maximum burner rig life, the distribution tends to be rather broad about the maximum. In Part 2, new hafnia-yttria-based coatings were evaluated against both baseline and alternate zirconia-yttria coatings. The hafnia-yttria coatings and the zirconia-yttria coatings that were prepared by an alternate powder vendor were very sensitive to plasma spray parameters, in that high-quality coatings were only obtained when certain parameters were employed. The reasons for this important observation are not understood. Also not understood is that the first of two replicate specimens sprayed for Part 1 consistently performed better than the second specimen. Subsequent experiments did not display this spray order affect, possibly because a chiller was installed in the torch cooling water circuit. Also, large changes in coating density were observed after switching to a new lot of electrodes. Analyses of these findings were made possible, in part, because of the development of a sensitive density measurement technique described herein in detail. The measured thermal diffusivities did not display the expected strong relationship with porosity. This surprising result was believed to have been caused by increased microcracking of the denser coatings on the stainless steel substrates. Author

N93-22592# Interior Dept., Washington, DC.
CONTINUOUS PRODUCTION OF GRANULAR OR POWDER Ti, Zr, AND Hf OR THEIR ALLOY PRODUCTS Patent Application
Jack C. White, inventor (to Interior Dept.) and Laurance L. Oden, inventor (to Interior Dept.) 5 Oct. 1992 12 p
(PB93-135051; US-Patent-Appl-SN-956235; Pat-Appl-7-956235) Avail: CASI HC A03/MF A01

The invention relates to continuous production of granular titanium, zirconium or hafnium metal or their alloys by: dissolving reducing metals such as sodium, magnesium or lithium in their respective halide salts to produce a reducing molten salt process stream; preparing a second molten salt stream bearing Ti, Zr, or Hf in solution; mixing and reacting the two molten salt process streams in a continuous stirred tank reactor where control of the concentrations of reactants, the contacting pattern, and the temperature produce orderly growth of granular metal free of halide inclusions; removing granular metal from the system; and leaching the remaining salts from the granular metal. Author

N93-22658# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Abt. Korrosion und Kristallzucht.
FRACTURE PROPERTIES OF 7010 AND 7050 ALUMINIUM ALLOYS UNDER INERT AND AGGRESSIVE ENVIRONMENTAL CONDITIONS [BRUCHVERHALTEN DER AL-LEGIERUNGEN 7010 UND 7050 IN INERTER UND AGGRESSIVER UMGEBUNG]
Horst Buhl, Reinhold Braun, C. Yuan (Chinese Aeronautical Establishment, Beijing.), and J. Helin (Chinese Aeronautical Establishment, Beijing.) Jul. 1991 63 p In GEORGIAN
(DLR-FB-91-35; ETN-93-91924) Avail: CASI HC A04/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The Stress Corrosion Cracking (SCC) behavior of plate material of the alloys 7010-T7651 and -T73651 as well as 7050-T73651 was investigated in the short transverse direction performing accelerated tests under constant load, constant deformation, and slow strain rate conditions. Details of the corrosive environments and tests are given together with the results. In the short transverse direction, tensile tests reveal a big scatter of the ductility of the alloys investigated. Using statistical evaluation methods it was shown that this scatter is caused by inhomogeneous distribution of Fe and Si containing constituent particles. ESA

N93-22692# Oak Ridge National Lab., TN.
CHARACTERIZATION OF DOPED NiAl BY ATOM PROBE FIELD ION MICROSCOPY
R. Jayaram and M. K. Miller 1992 6 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005932; CONF-921101-63) Avail: CASI HC A02/MF A01

The atom probe field ion microscope (APFIM) was used to characterize grain boundaries and matrix in NiAl doped with either boron, carbon or beryllium. Boron was observed to segregate to grain boundaries whereas carbon and beryllium did not. Atom probe analyses of the matrix revealed that the matrix was severely depleted of the solute in the boron- and carbon-doped alloys. Field ion imaging and matrix analyses also revealed ultrafine MB(sub 2) - and MC-type precipitates ranging in size between 2 run and 20 mm in diameter in the boron- and carbon-doped alloys. These precipitates occurred in significant number densities. Atom probe analyses of beryllium-doped NiAl did not reveal ultrafine precipitates and was consistent with the fact that almost all the beryllium was in solid solution. The enormous increase in yield stress in the boron- and carbon-doped alloys is predominantly due to a precipitation hardening effect. The small increase in yield stress in beryllium-doped NiAl is due to a mild substitutional solid solution hardening effect. DOE

N93-22698# Ecole Centrale de Lyon (France). Lab. des Materiaux Mecanique-Physique.
INFLUENCE OF ADDITION ELEMENTS IN COPPER OR IMPLANTED IN ALUMINUM ON THE ADHESION TO THE SOLID STATE OF THE COPPER/ALUMINUM (Cu/Al2O3) SYSTEM Ph.D. Thesis [INFLUENCE DES ELEMENTS D'ADDITION DANS LE CUIVRE OU IMPLANTES DANS L'ALUMINE SUR L'ADHERENCE A L'ETAT SOLIDE DU SYSTEME CUIVRE/ALUMINE (CU/AL2O3)]
Nacer Ikhlef 1991 191 p In FRENCH Sponsored by Algerian Ministere de l'Enseignement Superieur
(ECL-91-34; ETN-93-91956) Avail: CASI HC A09/MF A02

Materials and experimental techniques, in particular, means implemented for the addition of new elements either to copper (copper alloys) or aluminum by ion implantation, as well as by mixing a thin deposit of copper onto the aluminum substrate using ion beams, are described. Devices for the preparation and characterization of Cu/Al2O3 are presented. The influence of the physiochemical state of copper on the mechanical resistance of the CuAl2O3 bondings is studied. The ceramic part of the bonding is studied: grazing incidence x-ray diffraction analysis of the superficial layers of aluminum implanted (in Zr and Cu) or mixed (with Cu), with and without heat treatment; and mechanical resistance of the superficially treated copper/aluminum bondings. ESA

N93-22710# Boston Univ., MA. Dept. of Physics.
ATOMIC BEAM STUDIES OF THE INTERACTION OF HYDROGEN WITH TRANSITION METAL SURFACES
1992 37 p
(Contract DE-FG02-85ER-45222)
(DE93-006500; DOE/ER-45222/7) Avail: CASI HC A03/MF A01

We have constructed two experimental facilities during the term of this grant. In the first three years we constructed a helium atom scattering (HAS) facility with both elastic (EHAS) and inelastic (IHAS) scattering measurement capabilities to investigate the structural and dynamical aspects of solid surfaces and thin films. A pioneering surface metastable atom magnetic diffraction (SMAMD) facility was constructed and developed over the past four years, which makes possible the investigation of long-range electron spin-ordering on the surfaces of insulating magnetic crystals. The following were studied: H overlayers and Ag, Cu on Pd(111), reconstructed Au(111), and NiO(100). DOE

N93-22717# California Univ., Santa Cruz. Dept. of Physics.
EXPERIMENTAL STUDIES OF CRITICAL BEHAVIOR OF SYSTEMS WITH QUENCHED DISORDER
D. P. Belanger 1 Jul. 1992 23 p
(Contract DE-FG03-87ER-45324)
(DE93-005090; DOE/ER-45324/T2) Avail: CASI HC A03/MF A01

This document details progress made in the areas of: specific heat of random-field Ising antiferromagnets; the dilute Ising antiferromagnet near the percolation threshold; spin-echo neutron scattering; optical birefringence in SrTiO3; neutron scattering in epitaxial thin films; specific heat measurements in stacked triangular antiferromagnets; and the decay of the remnant magnetization in field-cooled antiferromagnets. DOE

N93-22724# Ames Lab., IA.
APPLICATION OF HIGH-RESOLUTION LASER SPECTROSCOPY TO THE MONITORING OF VAPOR-PHASE METALS
R. J. Lipert, Z. M. Wang, R. Schuler, and M. C. Edelson Oct. 1992 41 p
(Contract W-7405-eng-82)
(DE93-004432; IS-5076) Avail: CASI HC A03/MF A01

Research conducted in the Ames Laboratory Nuclear Safeguards and Security Program is reviewed. Progress in applying high-resolution laser spectroscopy to the monitoring of vapor-phase metals is described. The spectroscopic techniques employed include fluorescence excitation in an atomic beam, laser atomic absorption in a heat-pipe oven and atomic beam, Doppler-free saturated absorption in a heat-pipe oven, and Doppler-free polarization spectroscopy for the stabilization of the laser wavelength. DOE

N93-22738# Ames Lab., IA.
THEORETICAL STUDY OF ELECTRON-PHONON INTERACTION IN BETA-PHASE NiTi AND Ni-Al ALLOYS Ph.D. Thesis
Guang-Lin Zhao 17 Sep. 1992 88 p
(Contract W-7405-eng-82)
(DE93-004733; IS-T-1568) Avail: CASI HC A05/MF A01

The electronic band structure of (beta)-phase NiTi and NiAl was calculated using a first-principles LCAO method and then fitted by the nonorthogonal empirical tight binding method for the evaluation of electron-phonon (e-ph) matrix elements. Contribution of the e-ph interaction to phonon dynamical matrix was calculated by the method of Varma and Weber. It is found that an accurate calculation of e-ph interaction can explain the behavior of phonon anomalies in (beta)-phase NiTi and Ni-Al alloys. Fermi surface nesting and the symmetric properties of the e-ph interaction matrix elements are attributed as the source of the phonon anomalies and/or the soft phonon in these alloys. The temperature dependence of the phonon anomalies can be explained as a smearing effect of the Fermi surface. DOE

N93-22741# Argonne National Lab., IL.
PECULIARITIES OF STRUCTURES AND MELTINGLIKE TRANSITION IN GOLD CLUSTERS
I. L. Garzon and J. Jellinek 1992 4 p Presented at the 6th International Symposium on Small Particles and Inorganic Clusters, Chicago, IL, 16-22 Sep. 1992

(Contract W-31-109-eng-38)
(DE93-004810; ANL/CHM/CP-77993; CONF-920921-8) Avail: CASI HC A01/MF A01

Structural and dynamical properties of gold clusters are derived from a Gupta-type potential using numerical simulations and are compared to features of nickel clusters derived from the same potential. The major implication of the comparison is that the properties of clusters mimicked by this many-body potential depend, in general, on the values of its parameters. DOE

N93-22820# Ames Lab., IA.
SYNTHESIS, PROCESSING, AND PROPERTIES OF Ti5Si3
Y. Kim, A. J. Thom, and M. Akinc 1992 20 p Presented at the Minerals, Metals, and Materials Society/American Society for Metals (TMS/ASM) Materials Week 1992, Chicago, IL, 2-5 Nov. 1992
(Contract W-7405-eng-82)
(DE93-004465; IS-M-737; CONF-9211117-4) Avail: CASI HC A03/MF A01

Ti5Si3 was synthesized by arc melting of Ti and Si elemental powders. Ti5Si3 buttons were milled and sieved up to -325 mesh size powders, which were densified using HIPing. Microcracks in larger grains are observed for the HIPed microstructures with initial powder size of -325 mesh. Six hour milling of -325 mesh powder resulted in fine grain size (about 1 micron in diameter) with no microcracks after HIPing. Mechanical properties, such as hardness and fracture toughness, were measured for HIPed Ti5Si3. Thermal expansion coefficients along the a and c axis were measured as a function of temperature using a high temperature x-ray technique. Anisotropy in thermal expansion coefficient is believed to be one of the major causes for microcracks in larger grains. Oxidation behaviors of consolidated Ti5Si3 were investigated in terms of weight changes at 1000 C in air. DOE

N93-22880# Oak Ridge Y-12 Plant, TN.
MICROSTRUCTURE OF RAPIDLY-SOLIDIFIED LITHIUM POWDERS
M. D. Kass Dec. 1992 11 p
(Contract DE-AC05-84OS-21400)
(DE93-004765; Y/DZ-885) Avail: CASI HC A03/MF A01

Efforts are currently being made to produce lithium hydride powders by rapid solidification techniques. Two methods under investigation are gas atomization and melt spinning. Gas atomization produces powders having spherical morphology, while melt spinning produces ribbons which are ground into angular powder using a grinding mill. Both powder types are characterized for chemical, physical, and mechanical properties. The microstructures of the powders are currently being extensively analyzed. Rapid solidification techniques were used to form new phases, control particle size, control particle morphology, provide homogeneity of microstructure, and, most importantly, to produce fine grains. Although rapid solidification technologies are well established in the metal industry, very little research or development has been done on applying these processes to ceramic materials. DOE

N93-22881# Pacific Northwest Lab., Richland, WA.
POSTIRRADIATION DEFORMATION BEHAVIOR IN FERRITIC Fe-Cr ALLOYS
M. L. Hamilton, D. S. Gelles, and P. L. Gardner (Missouri Univ., Rolla.) Jun. 1992 17 p Presented at the 16th Annual Symposium of American Society of Testing and Materials (ASTM) on Effects of Radiation on Materials, Denver, CO, 21-25 Jun. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004833; PNL-SA-20060; CONF-920673-15) Avail: CASI HC A03/MF A01

It has been demonstrated that fast-neutron irradiation produces significant hardening in simple Fe-(3-18)Cr binary alloys irradiated to about 35 dpa in the temperature range 365 to 420 C, whereas irradiation at 574 C produces hardening only for 15 percent or more chromium. The irradiation-induced changes in tensile properties are discussed in terms of changes in the power law work-hardening exponent. The work-hardening exponent of the lower chromium alloys decreased significantly after low-temperature irradiation (less than or = 420 C) but increased after irradiation at 574 C. The higher chromium alloys failed either in cleavage or in a mixed ductile/brittle fashion. Deformation microstructures are presented to support the tensile behavior. DOE

N93-22882# Pacific Northwest Lab., Richland, WA.
MECHANICAL PROPERTIES OF MARTENSITIC ALLOY AISI 422
M. L. Hamilton, F. H. Huang (Westinghouse Hanford Co., Richland, WA.), and Wan-Liang Hu (Westinghouse Hanford Co., Richland, WA.) Jun. 1992 15 p Presented at the 16th Annual Symposium of American Society of Testing and Materials (ASTM) on Effects of Radiation on Materials, Denver, CO, 21-25 Jun. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004834; PNL-SA-19953; CONF-920673-14) Avail: CASI HC A03/MF A01

HT9 is a martensitic stainless steel that has been considered for structural applications in liquid metal reactors (LMRs) as well as in fusion reactors. AISI 422 is a commercially available martensitic stainless steel that closely resembles HT9, and was studied briefly under the auspices of the U.S. LMR program. Previously unpublished tensile, fracture toughness and charpy impact data on AISI 422 were re-examined for potential insights into the consequences of the compositional differences between the two alloys, particularly with respect to current questions concerning the origin of the radiation-induced embrittlement observed in HT9. DOE

N93-22912# Sandia National Labs., Albuquerque, NM.
MECHANICAL PROPERTIES OF FERRITIC AND FERRITIC-PEARLITIC DUCTILE IRON
I. H. Frenz (Bundesanstalt fuer Materialpruefung, Berlin, Germany.) Feb. 1993 141 p
(Contract DE-AC04-76DP-00789)
(DE93-007670; SAND-92-0421; TTC-0421) Avail: CASI HC A07/MF A02

A statistical analysis of test results on 1000 transportation and storage casks revealed the main parameters that determine the properties of DI (ductile iron, a special form of cost iron). These data were used to establish a test program in which the mechanical properties (particularly fracture toughness) of 24 DI alloys were determined as a function of their microstructure. Furthermore, the analysis emphasized the effect of test specimen size and different test data evaluation methods. Results of the test program show the prominent effect of pearlite content and graphite nodule structure in the mechanical and fracture toughness characteristics of DI. As the first-order parameter, the pearlite content is responsible for the transition from linear-elastic to elastic-plastic material behavior. The structure of the graphite nodules has a strong effect on the magnitude of the material property values. On the lower shelf, materials with small, homogeneously distributed graphite nodules show higher K(sub IC)-values (matrix-oriented fracture). On the upper shelf, materials with larger graphite nodules show higher fracture toughness (graphite-oriented fracture). With smaller specimens, conservative values were calculated on the upper shelf. This is important for transportation and storage containers of radioactive materials. DOE

N93-22924# EG and G Rocky Flats, Inc., Golden, CO.
FORMABILITY OF TYPE 304 STAINLESS STEEL SHEET
G. J. Coubrough, D. K. Matlock (Colorado School of Mines, Golden.), and C. J. VanTyne (Colorado School of Mines, Golden.) 1992 30 p Presented at the SAE Advanced Sheet Metal Forming Technology Conference, Detroit, MI, 1-6 Mar. 1993
(Contract DE-AC34-90DP-62349)
(DE92-018619; RFP-4607; CONF-930330-1) Avail: CASI HC A03/MF A01

Punch-stretch tests to determine formability of type 304 stainless steel sheet were conducted using a hemispherical dome test. Sheets of 19.1 mm width and 177.8 mm width were stretched on a 101.6 mm diameter punch at punch rates between 0.042 to 2.12 mm/s with three lubricant systems: a mineral seal oil, thin polytetrafluoroethelyne sheet with mineral seal oil, and silicone rubber with mineral seal oil. The resulting strain distributions were measured, and the amount of martensite was determined by magnetic means. Increasing lubricity resulted in more uniform strain distributions while increased punch rates tended to decrease both strain and transformation distributions. High forming limit values were related to the formation of high and uniformly distributed martensite volume fractions during deformation. The results of this study are interpreted with an analysis of the effects of strain and temperature on strain induced martensite formation in metastable austenitic stainless steels. DOE

N93-22943# Argonne National Lab., IL.
AMORPHIZATION KINETICS OF Zr(Cr,Fe)2 UNDER ION IRRADIATION
A. T. Motta (Pennsylvania State Univ., University Park.), L. M. Howe (Atomic Energy of Canada Ltd., Chalk River, Ontario.), and P. R. Okamoto Dec. 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-005560; ANL/MSD/CP-78354; CONF-921101-58) Avail: CASI HC A02/MF A01

Thin foils of Zircaloy-4 were irradiated with 350 KeV Ar-40 ions in the dual ion beam/HVEM facility at Argonne National Laboratory at 300-650 K. The irradiation-induced amorphization of the intermetallic precipitates Zr (Cr, Fe)2 and Zr2 (Ni, Fe) was studied in-situ. For Zr (Cr, Fe)2 precipitates the dose-to-amorphization was found to increase exponentially with temperature, with a critical temperature of about 650 K. The amorphization morphology was shown to be homogeneous, with no preferential site for nucleation, in contrast to neutron-irradiation amorphization which started at the precipitate-matrix interface. For Zr2 (Ni,Fe) precipitates it was found that amorphization occurred at 550 and 600 K, whereas in neutron irradiation no amorphization has been observed at those temperatures. The results are discussed in context of previous neutron and electron irradiations and likely amorphization mechanisms are proposed. DOE

N93-22977# Argonne National Lab., IL.
MOLECULAR DYNAMICS SIMULATION OF RADIATION-INDUCED AMORPHIZATION OF THE ORDERED COMPOUND NiZr2
R. Devanathan, N. Q. Lam, P. R. Okamoto, and M. Meshii (Northwestern Univ., Evanston, IL.) Dec. 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-005558; ANL/MSD/CP-76613; CONF-921101-38) Avail: CASI HC A02/MF A01

We have studied the electron irradiation-induced amorphization of the ordered intermetallic compound NiZr2 by molecular dynamics simulations in conjunction with embedded-atom potentials. Randomly chosen Frenkel pairs and chemical disorder were introduced into the system in separate processes. In both cases, the energy and volume of the system rose above the corresponding levels of a quenched liquid and the calculated diffraction patterns indicated the occurrence of a crystalline-to-amorphous transition. In addition, the average shear elastic constant fell to about 50 percent of its value in the perfect crystal and the system became elastically isotropic. These results indicate that NiZr2 can be amorphized by chemical disorder as well as Frenkel pairs and are in good agreement with experimental observations. DOE

N93-22981# University of Southern California, Los Angeles. Dept. of Chemistry.
CHEMISTRY OF BIMETALLIC AND ALLOY SURFACES
B. E. Koel 1992 14 p
(Contract DE-FG03-90ER-14117)
(DE93-006893; DOE/ER-14117/T3) Avail: CASI HC A03/MF A01

Recent research accomplishments included the following: a method for estimating surface reaction energetics, and its application to ethylene decomposition on Pt(111); carbon Auger line shapes for adsorption/decomposition of ethylene on Ni(100) and C-C bonding in 'carbidic' layers on metals; surface structure of Sn deposited on Pt(111) and Pt(100); chemisorption of CO, H2, and O2 on ordered Sn/Pt(111) surface alloys; effects of K adatoms on H2 adsorption on Pt(111); effects of adsorbed K, O, and H on CO adsorption on Pt(111); hydrocarbon trapping, condensation on Pt(111); effects of C on cyclohexane dehydrogenation on Pt(111) surfaces; and SnPt(111) catalysis of benzene production from acetylene under uhv conditions. DOE

N93-22991# Argonne National Lab., IL.
KINETIC ENERGY DISTRIBUTIONS OF SPUTTERED NEUTRAL ALUMINUM CLUSTERS: Al-Al6
S. R. Coon, W. F. Calaway, M. J. Pellin, G. A. Curlee (Trinity Univ., San Antonio, TX.), and J. M. White (Texas Univ., Austin.) 1992 26 p Presented at the Symposium on Sputtering, Copenhagen, Denmark, 30 Aug. - 4 Sep. 1992
(Contract W-31-109-eng-38)
(DE93-004815; ANL/CHM/CP-76899; CONF-9208147-2) Avail: CASI HC A03/MF A01

Neutral aluminum clusters sputtered from polycrystalline aluminum were analyzed by laser postionization time-of-flight (TOF) mass spectrometry. The kinetic energy distributions of Al through Al6 were measured by a neutrals time-of-flight technique. The interpretation of laser postionization TOF data to extract velocity and energy distributions is presented. The aluminum cluster distributions are qualitatively similar to previous copper cluster distribution measurements from our laboratory. In contrast to the steep high energy tails predicted by the single- or multiple- collision models, the measured cluster distributions have high energy power law dependences in the range of E(sup -3) to E(sup -4.5). Correlated collision models may explain the substantial abundance of energetic clusters that are observed in these experiments. Possible influences of cluster fragmentation on the distributions are discussed. DOE

N93-23024# Allied-Signal Aerospace Co., Kansas City, MO.
COMPARISON OF BISMUTH-LEAD AND BISMUTH-TIN TO TIN-LEAD AS ALTERNATE SOLDER ALLOYS
G. A. Becka Dec. 1992 43 p
(Contract DE-AC04-76DP-00613)
(DE93-006041; KCP-613-4996) Avail: CASI HC A03/MF A01

Bismuth-based alloys (Bi55.5-Pb44.5 and Bi58-Sn42) were evaluated as potential solder alloys by comparing certain metallurgical properties to Sn63-Pb37. This study shows that the two Bi-alloys are more creep-prone than Sn63. Also, both Bi-alloys are rapidly damaged by thermal cycling. Bi-Pb is a poor alternate solder alloy for high-reliability electronic solder joints. If Bi58-Sn42 is selected, the application should be thoroughly investigated to ensure metallurgical reliability. DOE

N93-23036# Westinghouse Savannah River Co., Aiken, SC.
CHARACTERIZATION OF SAES St198 ZIRCONIUM-IRON-TIN ALLOY
W. C. Mosley 13 Oct. 1992 15 p
(Contract DE-AC09-89SR-18035)
(DE93-005697; WSRC-TR-92-483) Avail: CASI HC A03/MF A01

A waste minimization program to develop a non-oxidative stripper system based on metallic getters is being conducted. Initial development is being performed using a Zr-Fe-Sn intermetallic alloy getter procured as St198 from SAES Getters/USA., Inc. This memorandum describes characterizations of physical and compositional properties of SAES St198. SAES St198 getter was supplied as very durable, cylindrical pellets made by compaction of granules of Zr-Fe-Sn alloy up to 150 micron in size. Pellet density was 5.2 g/mL corresponding to 24.8 percent open porosity and very little closed porosity. Bulk composition of St198 was 73.6 weight percent (w/o) Zr, 23.3 w/o Fe and 1.2 w/o Sn. St198 consists of Zr2Fe primary phase along with four secondary phases (ZrFe2, Zr5FeSn, alpha-zirconium, and eta-Zr4Fe2O(0.6)). Hydriding characteristics of St198 are expected to differ slightly from those of Zr2Fe because (alpha)-zirconium and, possibly, Zr5FeSn also react with hydrogen. DOE

N93-23193*# Virginia Univ., Charlottesville. Dept. of Materials Science and Engineering.
NASA-UVA LIGHT AEROSPACE ALLOY AND STRUCTURES TECHNOLOGY PROGRAM: LA(2)ST Progress Report, 1 Jul. - 31 Dec. 1992
Richard P. Gangloff, John K. Haviland, Carl T. Herakovich, Walter D. Pilkey, Marek-Jerzy Pindera, John R. Scully, Glenn E. Stoner, Earl A. Thornton, Franklin E. Wawner, Jr., and John A. Wert Mar. 1993 113 p
(Grant NAG1-745)
(NASA-CR-192354; NAS 1.26:192354; UVA/528266/MSE93/112) Avail: CASI HC A06/MF A02

The NASA-UVA Light Aerospace Alloy and Structures Technology (LA(2)ST) Program continues a high level of activity, with projects being conducted by graduate students and faculty advisors in the Departments of Materials Science and Engineering, Civil Engineering and Applied Mechanics, and Mechanical and Aerospace Engineering at the University of Virginia. This work is funded by the NASA-Langley Research Center under Grant NAG-1-745. We report on progress achieved between July 1 and December 31, 1992. The objective of the LA(2)ST Program is to conduct interdisciplinary graduate student research on the performance of next generation, light weight aerospace alloys, composites and thermal

gradient structures in collaboration with NASA-Langley researchers. Specific technical objectives are presented for each research project. We generally aim to produce relevant data and basic understanding of material mechanical response, corrosion behavior, and microstructure; new monolithic and composite alloys; advanced processing methods; new solid and fluid mechanics analyses; measurement advances; and critically, a pool of educated graduate students for aerospace technologies.

Derived from text

N93-23316# Eltech Systems, Inc., Fairport Harbor, OH.
PILOT DEMONSTRATION OF CERIUM OXIDE COATED ANODES Progress Report
J. S. Gregg, M. S. Frederick, M. J. Shingler, and T. R. Alcorn Oct. 1992 216 p
(Contract DE-FC07-90ID-12940)
(DE93-002507; DOE/ID-12940/1) Avail: CASI HC A10/MF A03

Copper cermet anodes were tested for 213 to 614 hours with an in-situ deposited CEROX coating in a pilot cell operated by Reynolds Manufacturing Technology Laboratory. At high bath ratio (approx. 1.5) and low current density (0.5 A/sq cm), a greater than or equal to 1 mm thick dense CEROX coating was deposited on the anodes. At lower bath ratios and higher current density, the CEROX coating was thinner and less dense, but no change in corrosion rate was noted. Regions of low current density on the anodes and sides adjacent to the carbon anode sometimes had thin or absent CEROX coatings. Problems with cracking and oxidation of the cermet substrates led to higher corrosion rates in a pilot cell than would be anticipated from lab scale results. DOE

N93-23368# Technical Research Centre of Finland, Espoo. Metals Lab.
THE SENSITIVITY IN EDDY CURRENT TESTING OF AUSTENITIC MATERIAL [PYORREVIRTAMENETELMAN HERKKYYS AUSTENIITTISEN MATERIAALIN TESTAUKSESSA]
Kari Lahdernperae Mar. 1992 41 p In FINNISH Sponsored by Oy Huber Testing Ab
(VTT-JULK-758; ISBN-951-38-4106-5; ETN-93-93478) Copyright Avail: CASI HC A03/MF A01

With the eddy current method it is possible to find and analyze surface defects of electrically conducting components. The method is most suitable for testing the components with simple geometries (sheets, tubes, threaded bolts). The sensitivity of several eddy current transducers was studied when the depth and length of the artificial surface defects change. The material of the specimens was austenitic steel. The artificial defects were narrow notches, closely resembling fatigue cracks. The defects were produced by the spark erosion technique. The effects of the liftoff and the angle of the transducer were studied. The 'noise level' due to geometrical and material inhomogeneity was measured. The transducers were of a commercial type. ESA

N93-23418*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AUGER ELECTRON SPECTROSCOPY STUDY OF OXIDATION OF A PdCr ALLOY USED FOR HIGH-TEMPERATURE SENSORS
Darwin L. Boyd (Kent State Univ., OH.), Mary V. Zeller, and Carlos Vargas-Aburto (Kent State Univ., OH.) Mar. 1993 34 p
(RTOP 763-22-51)
(NASA-TM-105961; E-7538; NAS 1.15:105961) Avail: CASI HC A03/MF A01

A Pd-13 wt. percent Cr solid solution is a promising high-temperature strain gage alloy. In bulk form it has a number of properties that are desirable in a resistance strain gage material, such as a linear electrical resistance versus temperature curve to 1000 C and stable electrical resistance in air at 1000 C. However, unprotected fine wire gages fabricated from this alloy perform well only to 600 C. At higher temperatures severe oxidation degrades their electrical performance. In this work Auger electron spectroscopy was used to study the oxidation chemistry of the alloy wires and ribbons. Results indicate that the oxidation is caused by a complex mechanism that is not yet fully understood. As expected, during oxidation, a layer of chromium oxide is formed. This layer, however, forms beneath a layer of metallic palladium. The results of this study have increased the understanding of the oxidation mechanism of Pd-13 wt. percent Cr.

Author (revised)

N93-23588 Virginia Univ., Charlottesville.
ELEVATED TEMPERATURE FRACTURE OF ADVANCED POWDER METALLURGY ALUMINUM ALLOY 8009 Ph.D. Thesis
William C. Porr, Jr. 1992 184 p
Avail: Univ. Microfilms Order No. DA9237626

Tensile and fracture toughness experiments were conducted on rapidly solidified, powder metallurgy processed 8009 (Al-8.5Fe-1.3V-1.7Si, wt percent). 8009 has high intrinsic initiation (K(sub IC)) and crack growth (T(sub R)) fracture toughnesses at 25 C, that decrease with increasing temperature and decreasing loading rate. K(sub IC) sharply decreases with increasing temperature from 25 to 175 C (from 33 to 15 MPa square root of m), and continues to gradually decrease with increasing temperature from 175 to 316 C (10 MPA square root of m). T(sub R) decreases to a minimum at 175 to 200 C, before increasing at higher temperatures. The tensile ductility of 8009, given by smooth and notched specimen area reductions, mirrors the temperature dependence of fracture toughness. Decreased loading rate at constant temperature has a similar effect as increasing temperature on the fracture toughness. SEM fractography indicated a change in the microscopic fracture mechanism of 8009 with increasing temperature and decreasing loading rate. At 25 C with moderate loading rates, a dual size distribution of microvoids was observed; large voids nucleated first at oxide particles, while small voids nucleated at dispersoids and contributed to a void sheeting fracture mechanism. At higher temperatures or lower loading rates, a single void size was observed, with voiding associated with nucleation at oxide particles in 8009. For the low toughness conditions, voids were shallow possibly due to cracking along localized slip bands. Micromechanical modelling accurately predicted the measured trends in K(sub IC) and T(sub R) with increasing temperature. The critical intrinsic variables controlling toughness behavior identified by the modelling was the high constraint crack tip strain, epsilon(sub f)*. Several mechanisms for the unusual fracture toughness and ductility degradation in 8009 were critically evaluated, including: dynamic strain aging due to excess solid solution iron, extrinsic delamination toughening, environmental embrittlement due to water vapor or oxygen reactions with aluminum, embrittlement by retained hydrogen from processing, or temperature enhanced localized deformation unique to ultrafine grain size alloys with a high volume fraction of strengthening dispersoids. The most likely mechanism for the degradation of fracture toughness and ductility in 8009 is a temperature and strain rate dependent transition in dispersoid-dislocation interactions. Dissert. Abstr.

N93-23642# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
MICROSTRUCTURE AND TEXTURE CONTROL OF FATIGUE IN HYDROGEN AND MARINE ENVIRONMENTS Fiscal Year Letter, 1 Oct. 1991 - 30 Sep. 1992
William W. Gerberich 30 Sep. 1992 9 p
(AD-A259808) Avail: CASI HC A02/MF A01

It is currently not understood how the anisotropic elastic, plastic and fracture characteristics interact with environment to limit fatigue life in a corrosive medium. This program examines how texture and anisotropic slip character interact in two general classes of BCC iron base and HCP titanium bare alloy systems. Selected area electron channeling, transmission electron microscopy, atomic force microscopy, continuous microindentation and fracture micromechanic methods are being utilized to evaluate microstructural and surface layer effects on environmentally-induced fatigue initiation. In addition, as it is essential to understand the transition from small crack to long crack behavior, additional threshold studies on both Fe-Si and HSLA polycrystals need to be accomplished. In this way, the various stages of nucleation and growth may be combined together for life prediction. The objective is to provide a partial basis for alloy and materials processing design against fatigue in a marine environment. GRA

N93-23672# Midwest Research Inst., Golden, CO.
MEASUREMENT OF THE RADIATIVE TRANSPORT PROPERTIES OF RETICULATED ALUMINA FOAMS
M. J. Hale and M. S. Bohn Dec. 1992 11 p Presented at the International American Society of Mechanical Engineers/ASES (ASME/ASES) Joint Solar Energy Conference, Washington, DC, 4-9 Apr. 1993
(Contract DE-AC02-83CH-10093)

(DE93-000047; NREL/TP-432-5071; CONF-930435-3) Avail: CASI HC A03/MF A01

This paper presents a method for determining radiative transport properties of reticulated materials. The method has both experimental and analytical components. A polar nephelometer is used to measure the scattering profile of a sample of the reticulated material. The results of a Monte Carlo simulation of the experiment are then combined with the experimental results to give the scatter albedo and extinction coefficient. This paper presents the results of using this method to determine the radiative transport properties of four different porosities (10, 20, 30, 65 pores per inch) of cylindrical reticulated alumina samples ranging in thickness from 0.5 inches to 2.5 inches. DOE

N93-23686# Los Alamos National Lab., NM.
RESIDUAL STRESS MEASUREMENTS IN CONTINUOUS FIBER TITANIUM MATRIX COMPOSITES
M. R. James (Rockwell International Corp., Thousand Oaks, CA.), M. A. Bourke, J. A. Goldstone, and A. C. Lawson 1992 9 p Presented at the Annual Denver X Ray Conference, Denver, CO, 3-7 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003733; LA-UR-92-3368; CONF-9208129-10) Avail: CASI HC A02/MF A01

Metal matrix composites develop residual strains after consolidation due to the thermal expansion mismatch between the reinforcement fiber and the matrix. X-ray and neutron diffraction measured values for the longitudinal residual stress in the matrix of three titanium MMCs are reported. For thick composites (greater than 6 plies) the surface stress measured by x-ray diffraction matches that determined by neutron diffraction and therefore represents the stress in the bulk region consisting of the fibers and matrix. For thin sheet composites, the surface values are lower than that in the interior and increase as the outer rows of fibers are approached. While a rationale for this behavior has yet to be developed, accounting for composite thickness is important when using x-ray measured values to validate analytic and finite element calculations of the residual stress state. DOE

N93-23704# Naval Air Warfare Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
NON-CHROMATED SURFACE PRETREATMENTS FOR ALUMINUM Interim Report, Oct. 1989 - Jun. 1992
Stephen J. Spadafora 18 Aug. 1992 44 p
(AD-A260130; NAWCADWAR-92077-60) Avail: CASI HC A03/MF A01

Chromates, particularly chromium VI, have been widely used in aerospace processes and materials due to their excellent performance as corrosion inhibitors. These processes range from inorganic pretreatment processes (alkaline cleaners, deoxidizers, conversion coatings, etc.) to organic protective coatings (primers, sealants, fuel tank coatings, etc.). Recently, regulatory agencies have enacted legislation to limit or prohibit the use and disposal of chromium containing materials because chromium VI is now a known carcinogen. These rules affect the majority of the pretreatment processes used on naval aircraft, necessitating the development of non-chromated replacements for the current materials. After an extensive research and development effort, several promising alternatives to chromated alkaline cleaners, deoxidizers, and conversion coatings have been identified. As a result of this work, implementation of non-chromate cleaning and deoxidizing materials at Naval Aviation Depots have already resulted in significant cost savings in both processing and waste disposal. Full implementation of these alternatives at all naval levels of maintenance (organizational, intermediate, and depot facilities) will result in a major reduction of hazardous waste generated by the Navy. This report describes the RDT and E effort to develop these non-chromated alternatives. GRA

N93-23955# Army Research Lab., Adelphi, MD.
COPPER/SOLDER INTERMETALLIC GROWTH STUDIES Interim Report, Oct. 1991 - May 1992
Kevin W. Kirchner, George K. Lucey, and James Geis Dec. 1992 14 p
(AD-A259856; ARL-TR-32) Avail: CASI HC A03/MF A01

A summary of initial findings from a series of experiments involving copper/solder intermetallic compounds (IMC's) is presented. Particularly the study examines the IMC's contribution to the changing physical properties of a solder joint as a function of time and temperature. In these experiments Cu/Sn joint samples were placed in the hot stage of an environmental scanning electron microscope, heated to about 170 C, and monitored for about 3 hr. A visual documentation of events is included. A real-time videotape record of the IMC growth was produced. Additionally a working hypothesis is presented that involves the relationship between IMC's and the mechanical properties of joints. GRA

N93-23971# Pacific Northwest Lab., Richland, WA.
BEND DUCTILITY OF TUNGSTEN HEAVY ALLOYS
W. E. Gurwell, M. R. Garnich, G. B. Dudder, and C. A. Lavender Nov. 1992 12 p Presented at the 1992 International Conference on Tungsten and Tungsten Alloys, Arlington, VA, 15-18 Nov. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004839; PNL-SA-21555; CONF-9211158-2) Avail: CASI HC A03/MF A01

A bend ductility test is used to indicate the formability of tungsten heavy alloys sheet. The primary test bends a notchless Charpy impact specimen to a bend angle of approximately 100 deg. This can be augmented by a bend-completion test. Finite element modeling as well as strain-gaged bend specimens elucidate the strain distribution in the specimen as a function of material thickness and bend angle. The bend ductilities of 70, 80, and 90 percent W alloys are characterized. As expected, decreasing thickness or tungsten content enhances bend ductility. Oxidation is not detrimental; therefore, controlled atmosphere is not required for cooling. The potentially detrimental effects of mechanical working (e.g., rolling, roller-leveling, grit blasting, and peening) and machining (e.g., cutting and sanding) are illustrated. DOE

N93-23972# Pacific Northwest Lab., Richland, WA.
EFFECTS OF ROLLING ON THE DUCTILITY OF 80 PERCENT TUNGSTEN HEAVY ALLOY
C. A. Lavender and W. E. Gurwell Nov. 1992 10 p Presented at the 1992 International Conference on Tungsten and Tungsten Alloys, Arlington, VA, 15-18 Nov. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004840; PNL-SA-21556; CONF-9211158-1) Avail: CASI HC A02/MF A01

Relations between transverse tensile ductility and rolling and annealing schedules were investigated for solid-state sintered and annealed (80)W(8)Ni(2)Fe heavy alloy rolled at 900 C or 1150 C with varying reductions between anneals at either 1150 C or 1400 C. Final anneals and a solution heat treatment were employed prior to tensile testing. Metallographic and fractographic analyses were performed to determine relations between microstructure and physical properties. Multiple 1400 C intermediate anneals with a maximum 60 percent rolling reduction produced higher transverse tensile elongations than rolled with a higher final reduction, 86 percent. Tensile elongation differences were attributed to the recrystallized intra-particle W grain sizes achieved during the final anneal. Materials given a maximum of 60 percent reduction before final anneal had fewer intra-particle W grains and therefore higher ductilities. For materials rolled at 900 C or 1150 C, no differences in transverse tensile elongation were observed. 1150 C intermediate anneals had consistently lower ductility. 900 C rolling produced slightly higher elongations than 1150 C rolling, but only when the material was annealed at 1455 C. Tensile yield and ultimate strengths did not vary greatly with rolling and intermediate annealing conditions. The edge cracking correlated with observed lateral spread and the material softness. DOE

N93-23980# Pacific Northwest Lab., Richland, WA.
GRAIN BOUNDARY CHEMISTRY EFFECTS ON ENVIRONMENT-INDUCED CRACK GROWTH OF IRON-BASED ALLOYS
R. H. Jones Nov. 1992 8 p Presented at the Minerals, Metals, and Materials Society/American Society for Metals (TMS/ASM) Materials Week 1992, Chicago, IL, 2-5 Nov. 1992
(Contract DE-AC06-76RL-01830)
(DE93-005039; PNL-SA-21327; CONF-9211117-3) Avail: CASI HC A02/MF A01

Relation between grain boundary chemistry and environment-induced crack growth of Fe-based alloys is reviewed. The importance of the cleanliness of steels is clearly demonstrated by direct relations between grain boundary chemistry and crack growth behavior for both H and anodic dissolution-induced crack growth. Relationships between strain to failure, work of fracture, K(sub ISCC), crack velocity and fracture mode and grain boundary chemistry are presented. Only results in which the grain boundary

chemistry has been measured directly by Auger electron spectroscopy (AES) on intergranular surfaces exposed by in situ fracture have been considered in this review. DOE

N93-23982# Geo-Microbial Technologies, Inc., Ochelata, OK.
IDENTIFICATION OF SPECIFIC PROTEIN MARKERS THAT CORRELATE WITH INITIATION AND PROGRESSION OF MICROBIALLY INFLUENCED CORROSION Final Report
Victoria Gonzales-Prevatt 1992 34 p
(Contract N00014-92-C-0063)
(AD-A258453) Avail: CASI HC A03/MF A01

The feasibility of using sodium dodecyl sulfate polyacrylamide gel electrophoresis and 2-dimensional gel electrophoresis as techniques for identification of specific protein markers that correlate with initiation and progression of microbially influenced corrosion was demonstrated during phase 1. Results showed that proteins can be detected in extracts of oil pipeline pigging solids and in concentrated water samples from locations where corrosion coupon data show evidence of corrosion. Different protein banding patterns were observed for samples collected from different locations. Samples collected from the same location at different times also showed a slight change in banding pattern. These results are significant because changes in protein banding patterns can be indicative of changes in microbioal populations or of metabolic activities associated with initiation of microbially influenced corrosion (MIC). Capability to detect proteins in water samples is especially significant because identification of markers in the water will provide the earliest indication of MIC. The need for optimizing sample preparation procedures to remove interfering components and conditions for 2-D electrophoresis to obtain maximum resolution was discussed. Recommendations for future research in phase 2 that would lead to development of a simple and economical diagnostic procedure for early identification of MIC were made. Author

N93-24014# Xform, Inc., Cohoes, NY.
ANALYSIS OF RESIDUAL PHASES IN NICKEL ALUMINIDE POWDERS PRODUCED BY REACTION SYNTHESIS
K. P. McCoy, K. G. Shaw, and J. A. Trogolo (Rensselaer Polytechnic Inst., Troy, NY.) 1992 6 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-FG01-91CE-15492)
(DE93-005680; CONF-921101-34) Avail: CASI HC A02/MF A01

The use of x-ray diffraction has been used to determine phases present after reaction synthesis of Ni3Al powder. The complex diffraction spectra produced by the powder prompted the development of a simulator. The simulator uses nonlinear regression to determine the weight percent of the phases present. The simulator also determines the broadening of each peak in the spectrum. The phases present in Ni3Al powder produced by reaction synthesis has been determined with the simulator. The simulator has been used to monitor the progress of phase transformation during various thermal treatments of Ni3Al powder. A thermal cycle of 1200 C for two hours has been shown to produce a phase-pure product. The activation energy for the interdiffusion of nickel and aluminum has been determined to be 260 + or - 35 kJ/mole. DOE

N93-24037# Oak Ridge National Lab., TN.
THE MAGNETISM OF METALLIC MANGANESE ALLOYS
T. M. Holden (Atomic Energy of Canada Ltd., Chalk River, Ontario.), K. Mikke (Institute of Atomic Energy, Otwock, Poland.), E. Fawcett (Toronto Univ., Ontario.), and J. A. Fernandez-Baca 1992 7 p Presented at the International Conference on the Physics of Transition Metals, Darmstadt, Germany, 20-24 Jul. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005153; CONF-920762-9) Avail: CASI HC A02/MF A01

The magnetic excitations in antiferromagnetic manganese-copper and manganese-iron alloys are characterized by high spin-wave velocities, and energy gap at long wavelengths and wavelength dependent damping. There are strong elastic constant anomalies above T(sub N) as well as magnetoelastic distortions below T(sub N). The theoretical explanation of these effects is reviewed. DOE

N93-24048# Sandia National Labs., Albuquerque, NM.
SOLUTE BINDING AT VOID SURFACES IN SILICON AND GERMANIUM
S. M. Myers, D. M. Bishop, D. M. Follstaedt, H. J. Stein, and W. R. Wampler 1992 8 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-004504; SAND-92-1443C; CONF-921101-17) Avail: CASI HC A02/MF A01

The strongly exothermic reactions of H and Cu with internal surfaces in Si and Ge were examined in experiments employing ion implantation, ion-beam analysis, transmission electron microscopy, and infrared spectroscopy. The dissociation energy of the Si-H surface bond was determined to be 2.6 +/- 0.1 eV, making the monohydride more stable than the molecular H2, whose dissociation energy per atom is 2.26 eV. Initial experiments indicate a dissociation energy for the Ge-H surface bond of approx 1.9 eV. Copper is bound to the Si surface with an energy of 2.2 +/- 0.2 eV relative to the sqlution state, as compared to a reported binding energy of 1.5 eV for Cu in the precipitated Cu3Si phase. DOE

N93-24098# North Carolina State Univ., Raleigh.
A STUDY INTO THE EFFECTS OF ELECTRIC FIELDS AND CURRENTS ON THE AGING AND QUENCH HARDENING OF STEELS Final Report
Hans Conrad 15 Jan. 1993 78 p
(Contract DAAL03-89-K-0115)
(AD-A260228; ARO-26825.21-MS) Avail: CASI HC A05/MF A01

Studies were conducted on the effects of an internal electric current and an external electric field on the mechanical properties of metals and on solid state transformations therein, giving attention to the quench aging of a low-carbon steel and the hardenability of a tool steel. A continuous d.c. current of approximately 10(exp 3) A/cm(sup 2) increased the rate of quench aging at 80 C, whereas an a.c. current of the same magnitude and a frequency of 50-100 Hz dramatically suppressed the aging. An external electric field of approximately 14 kV/cm retarded the quench aging by altering the nature of the precipitation process. Regarding hardenability, an external electric field of 1 kV/cm increased the hardenability of a tool steel by shifting the CT curve to longer times. It was further established that high density d.c. pulses (greater than or equal to 10(exp 3) A/cm(sup 2) of approximately 100 microns duration) increased the plastic strainrate of metals by orders of magnitude, increased fatigue life, and enhanced the rates of recovery and recrystallization but retarded grain growth. An external electric field of approx. 1 kV/cm reduced the flow stress during the superplastic deformation of 7475 Al, retarded grain growth, and significantly reduced the cavitation. The effects of the electric current and external field on the various phenomena are explained in terms of their influence on the mobility of point (vacancies and solute atoms) and line (dislocation) crystal defects. GRA

N93-24112# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
A NEW INDEX FOR THE CREVICE CORROSION RESISTANCE OF MATERIALS
Yuan Xu and Howard W. Pickering Feb. 1993 21 p
(Contract N00014-91-J-1189)
(AD-A260437) Avail: CASI HC A03/MF A01

Recent studies have revealed the crucial role played by the macro corrosion cell (potential coupling between the inside and outside of a cavity) in crevice and pitting corrosion. It was found that acidification and the existence of chloride ions in the local cell are not the sole and necessary conditions for localized corrosion to occur, and that their accelerating effects on crevice corrosion and pit growth can be explained within the framework of the macro cell (the IR drop mechanism). Upon analysis of the results of the experiments, quantitative modeling, and the literature, a new characteristic parameter the critical distance into the crevice, d(sub c), was suggested for indexing the crevice corrosion resistance of a material under specified conditions. The advantages of using d(sub c) as the index of the crevice corrosion resistance are: (1) it may be obtained through experiment and may also be estimated through computational approaches; (2) it has a distinct and straightforward physical meaning; (3) it may be employed in engineering design; and (4) it is a single parameter which can reflect the integrated influence of several factors known to affect the crevice corrosion resistance of a material from past practical experience and research work. Preliminary work has shown good agreement

between the measured and the computed values of d(sub c). The experimental technique and the principle of the mathematical approach to obtain d(sub c) are described. GRA

N93-24233# Puerto Rico Univ., Rio Piedras. Dept. of Physics.
SEQUENTIAL DEPOSITION OF COPPER ON SOLID GOLD (111): A STATISTICAL MODEL
L. Blum and Dale A. Huckaby 15 Jan. 1993 13 p Prepared in cooperation with Texas Christian Univ., Fort Worth
(Contract N00014-90-J-1263)
(AD-A260269; TR-22) Avail: CASI HC A03/MF A01

Phase transitions occurring during electrode processes have been studied using a model in which the electrode is a planar wall with sticky adsorption sites. This model is used to explain the underpotential deposition (UPD) of copper on gold (111) in the presence of bisulfate ions. The model assumes that the bisulfate ions form a template for the adsorption of the first 2/3 of a monolayer of copper onto a honeycomb lattice. The centers of the hexagons that form the honeycomb are occupied by the bisulfate. In the absence of copper the bisulfate is desorbed as the electrode becomes more negatively charged, and for that reason the template 'melts' when the fraction of occupied sites drops below a certain critical value, which is estimated using the hard hexagon model. We assume strong copper-bisulfate coadsorption, so that in the presence of a sufficiently large amount of Cu the template is reconstructed. Our model explains the qualitative features of the voltammogram, and makes definite predictions for the structure that should be observed. GRA

N93-24237# Puerto Rico Univ., Rio Piedras. Dept. of Physics.
A MODEL FOR VOLTAMMOGRAMS OF THE UNDER-POTENTIAL DEPOSITION OF COPPER ON SOLID GOLD (111) IN THE PRESENCE OF BISULFATE
L. Blum and Dale A. Huckaby 15 Jan. 1993 15 p
(Contract N00014-90-J-1263)
(AD-A260309; TR-24) Avail: CASI HC A03/MF A01

A model for the underpotential deposition of Cu on Au(111) in the presence of H2SO4, was recently proposed. In this model we assumed that the HSO4(-) ions formed a square root of 3 x square root of 3 lattice which produced a honeycomb template for the deposition of the copper. This results in the electrodeposition of about 3/3 of the copper of a monolayer, corresponding to the first peak in the voltammogram. The second peak, of about 1/3 of the Cu of the full monolayer, is due to the displacement of the HSO4(-), by copper. In our previous work we assumed that the HSO4(-), template was in place during the whole electrodeposition process. However, from recent experimental evidence we know that this is not so. An improved effective field model in which the electrodeposition potential of the HSO4(-) changes with the amount of adsorbed copper is suggested. This new model reproduces the shape of the first peak of the voltammogram, and explains the transition of a broad peak to a narrow one by a second order phase transition (hard hexagon model) of the adsorbed HSO4(-). GRA

N93-24269# Naval Surface Warfare Center, Bethesda, MD. Ship Materials Engineering Dept.
RELATING POROSITY AND MECHANICAL PROPERTIES IN SPRAY FORMED ALLOY 625 Research Report, Feb. - Oct. 1992
R. D. Payne, A. L. Moran, and R. C. Cammarata 27 Oct. 1992 20 p
(AD-A260341; CDNSWC/SME-92-54) Avail: CASI HC A03/MF A01

Previous studies of spray formed material at the Carderock Division, Naval Surface Warfare Center, Annapolis Detachment, have indicated that porosity is one of the few component characteristics affected by changes in process parameters. As a result, porosity has often been directly linked to quality. The relationship between porosity and mechanical properties is examined in an effort to prove that porosity does indeed indicate quality. In general, increases in porosity lead to decreases in strength and hardness. This allows the generalization that higher porosity levels indicate lower quality material. GRA

N93-24329# Oak Ridge National Lab., TN.
ACCEPTABLE ALUMINUM ADDITIONS FOR MINIMAL ENVIRONMENTAL EFFECT IN IRON-ALUMINUM ALLOYS
Vinod K. Sikka, Srinath Viswanathan, and Sanjay Vyas (Carnegie-Mellon Univ., Pittsburgh, PA.) 1992 6 p Presented at the Materials Research Society (MRS) Symposium, Boston, MA, 2-6 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-006738; CONF-921206-10) Avail: CASI HC A02/MF A01

A systematic study of iron-aluminum alloys has shown that Fe-16 at. percent Al alloys are not very sensitive to environmental embrittlement. The Fe-22 and -28 at. percent Al alloys are sensitive to environmental embrittlement, and the effect can be reduced by the addition of chromium and through the control of grain size by additions of zirconium and carbon. The Fe-16 at. percent Al binary, and alloys based on it, yielded over 20 percent room-temperature (RT) elongation even after high-temperature annealing treatments at 1100 C. The best values for the Fe-22 and -28 at. percent Al-base alloys after similar annealing treatments were 5 and 10 percent, respectively. A multicomponent alloy, FAP, based on Fe-16 at. percent Al was designed, which gave an RT ductility of over 25 percent. DOE

N93-24499# Forschungszentrum Juelich G.m.b.H. (Germany). Inst. fuer Festkoerperforschung.
PHASE STABILITY AND ELECTRONIC STRUCTURE OF TRANSITION-METAL ALUMINIDES
A. E. Carlsson 1992 7 p Presented at the International Conference on the Physics of Transition Metals, Darmstadt, Germany, 20-24 Jul. 1992
(Contract DE-FG02-84ER-45130)
(DE93-003584; CONF-920762-8) Avail: CASI HC A02/MF A01

This paper will describe the interplay between the electronic structure and structural energetics in simple, complex, and quasicrystalline Al-transition metal (T) intermetallics. The first example is the Ll2-DO22 competition in Al3T compounds. Ab-initio electronic total-energy calculations reveal surprisingly large structural-energy differences, and show that the phase stability of both stoichiometric and ternary-substituted compounds correlates closely with a quasigap in the electronic density of states (DOS). Secondly, ab-initio calculations for the structural stability of the icosahedrally based Al12W structure reveal similar quasigap effects, and provide a simple physical explanation for the stability of the complex aluminide structures. Finally, parametrized tight-binding model calculations for the Al-Mn quasicrystal reveal a large spread in the local Mn DOS behavior, and support a two-site model for the quasicrystal's magnetic behavior. DOE

N93-24566# Lehigh Univ., Bethlehem, PA. Dept. of Mechanical Engineering and Mechanics.
CORROSION FATIGUE OF IRON-CHROMIUM-NICKEL ALLOYS: FRACTURE MECHANICS, MICROSTRUCTURE AND CHEMISTRY
R. P. Wei 25 Jan. 1993 11 p
(Contract DE-FG02-88ER-45354)
(DE93-007971; DOE/ER-45354/5) Avail: CASI HC A03/MF A01

Phase transformation and cracking during RT aging of charged, high-purity Fe18Cr12Ni alloy and commerical 304 SS were examined; results show that epsilon(*) (hcp) hydride formed on Fe18Cr12Ni upon charging, and it decomposed rapidly to form first epsilon and then alpha' martensite. Morphology of fracture surfaces of Fe18Cr12Ni produced by corrosion fatigue in NaCl solutions and in hydrogen was found to be identical. Effort was made to examine the approaches and methodologies used in service life predictions and reliability analyses. DOE

N93-23936 Martin Marietta Corp., Baltimore, MD.
DESIGN OF AN ULTRA-HIGH-STRENGTH WELDABLE Al-Cu-Li ALLOY FOR SPACE APPLICATIONS
J. R. Pickens, F. H. Heubaum, and T. J. Langan *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 3-25 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

N93-23937 Aluminum Co. of America, Alcoa Center, PA.
INVESTIGATION OF GAS METAL ARC WELDING CHARACTERISTICS OF ALLOY 6013
Frank G. Armao *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 27-42 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum,

Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N93-22033* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

POLYIMIDE FROM BIS(N-ISOPRENYL)S OF ARYL DIAMIDES Patent

Joseph G. Smith, Jr., inventor (to NASA) and Raphael M. Ottenbrite, inventor (to NASA) 6 Apr. 1993 6 p Filed 16 Aug. 1990 Supersedes N91-13560 (29 - 5, p 642)

(NASA-Case-LAR-14330-2-CU; US-Patent-5,200,497; US-Patent-Appl-SN-568128; US-Patent-Class-526-262; US-Patent-Class-528-170; US-Patent-Class-528-321; US-Patent-Class-528-322; Int-Patent-Class-C08F-222/40) Avail: US Patent and Trademark Office

A process and polyimide product formed by the reaction of a bismaleimide with a bis(amidediene) is disclosed wherein the bis(amidediene) is formed by reacting an excess of an acid chloride with 1,4-N,N'-diisoprenyl 2,3,5,6-tetramethy1 benzene.

Official Gazette of the U.S. Patent and Trademark Office

N93-22048# Ames Lab., IA.

SPUTTER-DEPOSITION AND CHARACTERIZATION OF MOLYBDENUM DISULFIDE THIN FILMS Ph.D. Thesis

J. Obeng Sep. 1992 166 p

(Contract W-7405-eng-82)

(DE93-004801; IS-T-1597) Avail: CASI HC A08/MF A02

MoS(x) films were deposited on Si substrates by rf planar magnetron sputtering of hot-pressed MoS2 in Ar or H2S/Ar and of Mo in H2S/Ar. Results indicated that MoS(x) film properties can be controlled more easily by sputtering Mo in H2S/Ar. The surface-sensitive technique of IRRAS (infrared reflection-absorption spectroscopy) was used to study CO adsorption on MoS(x) thin films sputter-deposited on Si, Au/Si, and Pt/Si substrates. The spectra suggested mainly gas phase CO with multiple absorption bands about the 2162 and 2114 cm(sup -1) regions for CO pressures over 30 torr; no CO bands were observed for monolayer coverages. Progress was made in sputter-depositing MoS(x)/metal/Si thin films with preferred orientation. DOE

N93-22329# Oak Ridge National Lab., TN.

EVALUATION OF CERAMIC MATERIALS FOR AN ADVANCED STEAM-METHANE REFORMER

J. R. Keiser, J. I. Federer, J. J. Williams (Stone and Webster Engineering Corp., Boston, MA.), and R. A. Rosenberg (Stone and Webster Engineering Corp., Boston, MA.) 1993 15 p Presented at the NACE Annual Corrosion Conference and Materials Performance and Corrosion Show, New Orleans, LA, 7-12 Mar. 1993

(Contracts DE-AC05-84OR-21400; DE-FC02-88ID-12797)

(DE93-005931; CONF-930318-4) Avail: CASI HC A03/MF A01

Four ceramic materials (three silicon carbides and one silicon carbide particle-strengthened alumina composite) were corrosion tested to assess their suitability for application as tubes for a steam-methane reformer. Corrosion tests were conducted in simulated reformer atmospheres at temperatures in the range 595 to 1040 C. The fragmented, non-adherent oxide layer (cristobalite) that formed on SiC ceramics increased in thickness with increasing temperature, steam partial pressure, and exposure time. The SiC-Al2O3 composite also formed a thin reaction zone as SiC particles near the surface oxidized and then reacted with residual aluminum alloy or the alumina matrix, but, unlike the oxide layer on the SiC ceramics, the reaction zone thickness did not increase with exposure time. The strengths of the ceramic materials were measured using four-point flexure tests. Based on the limited data available, none of the materials showed a significant strength change that could be related to exposure temperature or steam partial pressure. For all four materials at 1040 C, the samples with the longest exposure time showed the lowest strength; however, this decrease was probably not statistically significant, given the limited number of samples tested. DOE

N93-22341# Los Alamos National Lab., NM.

STRUCTURE, MECHANICAL PROPERTIES, AND OXIDATION BEHAVIOR OF NANOLAYERED MoSi2/SiC COATINGS

J.-P. Hirvonen (Technical Research Centre of Finland, Espoo.), H. Kattelus (Technical Research Centre of Finland, Espoo.), J. Likonen (Technical Research Centre of Finland, Espoo.), I. Suni (Technical Research Centre of Finland, Espoo.), R. Lappalainen (Helsinki Univ., Finland.), H. Kung, T. R. Jervis, and M. Nastasi 1992 14 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992

(Contract W-7405-eng-36)

(DE93-005472; LA-UR-92-4298; CONF-921101-50) Avail: CASI HC A03/MF A01

Structure, hardness, elastic properties, and oxidation of nanolayered MoSi2/SiC were examined. DC-magnetron and RF-diode sputtering were used to deposit MoSi2 and SiC, respectively. Total number of sublayers of each kind was 90. Nominal thickness of MoSi2 sublayers was 10 and that of SiC3 nm. As-deposited microstructure was amorphous whereas annealing at 500C for 1 h resulted in transformation of MoSi2 into C40 type hexagonal structure. However, silicon carbide remained still amorphous. Hardness of 11.6 and 20.8 GPa were obtained for as-deposited and annealed structure; Young moduli were 220 and 290 GPa, which yield 232 and 332 GPa for Young moduli of amorphous and crystalline MoSi2. Oxidation tests were carried out in wet conditions at 400 and 500C; degree of oxidation was determined using the reaction O(d,p)-16 O-17 at 950 keV. The MoSi2/SiC coating gave a good protection against oxidation for unalloyed steel. As compared to a single MoSi2 coating, a slightly higher degree of oxidation and a significantly different mechanism of oxidation was observed. This was also supported by secondary ion mass spectroscopy. Cracking of the coating caused by a thermal mismatch and transformation stresses was worse in the case of the single MoSi2 layer than in the case of the composite coating. Thus, cracking of the coating can be significantly reduced by using a nanolayered structure. DOE

N93-22409# Tennessee Univ., Knoxville. Dept. of Chemistry.

INVESTIGATIONS OF THE EFFECTS OF ISOTOPIC SUBSTITUTION AND PRESSURE OF MISCIBILITY IN POLYMER-POLYMER AND POLYMER-SOLVENT SYSTEMS

A. VanHook 1992 6 p

(Contract DE-FG05-88ER-45374)

(DE93-005115; DOE/ER-45374/1) Avail: CASI HC A02/MF A01

Design, construction, and calibration of the polymer-solvent light scattering apparatus is complete. Preliminary results for the polystyrene-acetone system were reported; also, some theory was developed. Measurements on the polystyrene-acetone and polystyrene-methyl cyclopentane systems were completed (an abstract is included). Near tri-critical behavior is exhibited in the acetone-polystyrene system in its hypercritical point. Data on phase separation in polymer-polymer solutions by light scattering using spinodal quench techniques were obtained. Methods were worked out to synthesize perdeutero-methylcyclopentane and 1,1-dideuteropropionitrile. A review article was prepaired summarizing the field of isotopomer solution thermodynamics. DOE

N93-22422# Texas Univ., Austin. Dept. of Chemical Engineering.

SYNTHESIS AND ANALYSIS OF NOVEL POLYMERS WITH HIGH PERMSELECTIVITY AND PERMEABILITY IN GAS SEPARATION APPLICATIONS

W. J. Koros and D. R. Paul 31 Dec. 1991 14 p

(Contract DE-FG05-86ER-13507)

(DE93-005883; DOE/ER-13507/8) Avail: CASI HC A03/MF A01

Significant progress was made toward developing advanced materials for gas separation membrane applications and rationalizing molecular structure and efficacy. The following goals were accomplished: synthesized and tested polyarylates based on terephthalic or isophthalic acid or a tertiary butyl derivative of the isophthalic acid with different diols; completed high temperature characterization of sorption and transport properties for novel materials; continued studies of the phenyl-substituted polymers aimed at producing super stable high temperature useful polymers for gas

separations; and synthesized a polyarylate based on the spirobiindane diol and bibenzoyl acid chloride to incorporate long flat packable bibenzoyl units between packing disruptive spirobiindane units in an attempt to control the segmental level morphology to produce highly selective 'bottleneck' regions between highly open regions. DOE

N93-22460# Ecole Centrale de Lyon (France). Lab. de Mecanique des Solides.

MICROSTATIC STUDY OF THE BEHAVIOR OF GRANULAR MEDIA Ph.D. Thesis [ETUDE MICROSTATIQUE DU COMPORTEMENT DES MILIEUX GRANULAIRES]

Abdulrahman Al-Mansouri 1990 187 p In FRENCH

(ECL-90-31; ETN-93-91947) Avail: CASI HC A09/MF A02

An attempt to link microstructural phenomena and the global behavior of granular media which are considered to be continuous is presented. A bibliographical study is presented to analyze the links between experimental results and the microstructural phenomena and show what microstructural analysis can contribute to the constitutive equations. A microstatical analysis for the behavior of granular materials is proposed. The general framework of a completely microstructural approach is defined and the relationships of the microstatical approach are presented. This leads to the proposal of functions whose discretization allows the internal state of these materials to be described by a limited number of parameters. An expression of the global behavior criterion is proposed. The yielding surfaces and failure surface are presented. A global constitutive model for granular materials based on microstructural considerations is proposed. The numerical results obtained are in good agreement with experimental results and prove the advantage of this kind of analysis. ESA

N93-22528# New York State Coll. of Ceramics, Alfred.

STRUCTURE, STOICHIOMETRY AND STABILITY IN MAGNETOPLUMBITE AND (BETA)-ALUMINA TYPE CERAMICS

A. N. Cormack and J. G. Park Dec. 1992 5 p

(Contract DE-FG02-91ER-45451)

(DE93-007303; DOE/ER-45451/2) Avail: CASI HC A01/MF A01

Work has continued on the computer simulation of atomic scale defect complexes in polyaluminates with the magnetoplumbate and beta-alumina structures. More stringent criteria have been developed for determining the viability of interatomic potential models for these complex structured materials, details of the cation coordination having been found to be important. It appears that the energetics of point defect complex formation is the reason why Ba hexa-aluminate does not adopt the magnetoplumbate structure, in contrast to Sr hexa-aluminate, which does. DOE

N93-22557*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

A SUMMARY OF LABORATORY TESTING PERFORMED TO CHARACTERIZE AND SELECT AN ELASTOMERIC O-RING MATERIAL TO BE USED IN THE REDESIGNED SOLID ROCKET MOTORS OF THE SPACE TRANSPORTATION SYSTEM

J. E. Turner Feb. 1993 38 p

(NASA-TM-108395; NAS 1.15:108395) Avail: CASI HC A03/MF A01

An elastomeric O-ring material is used in the joints of the redesigned solid motors (RSRM's) of the National Space Transportation System (NSTS). The selection of the O-ring material used in the RSRM's was a very thorough process that included efforts by NASA's Marshall Space Flight Center and the Langley Research Center, and the Thiokol Corporation. One of the efforts performed at MSFC was an extensive in-house laboratory test regime to screen potential O-ring materials and ultimately to characterize the elastomeric material that was chosen to be used in the RSRM's. The laboratory tests performed at MSFC are summarized. Author

N93-22560*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

INTERFACIAL CHEMISTRY OF A PERFLUOROPOLYETHER LUBRICANT STUDIED BY XPS AND TDS

Pilar C. Herrera-Fierro, William R. Jones, Jr., and Stephen V. Pepper Apr. 1992 39 p

(RTOP 505-63-5A)

(NASA-TM-106014; E-6889-1; NAS 1.15:106014) Avail: CASI HC A03/MF A01

The interfacial chemistry of Fomblin Z25, a commercial perfluoropolyether used as lubricant for space applications, with different metallic surfaces: 440C steel, gold and aluminum was studied. Thin layers of Fomblin Z25 were evaporated onto the oxide-free substrates and the interfacial chemistry studied using XPS and TDS. The reactions were induced by heating the substrate and by rubbing the substrate with a steel ball. Gold was found to be completely unreactive towards Fomblin at any temperature. Reaction at room temperature was observed only in the case of the aluminum substrate, the most reactive towards Fomblin Z25 of the substrates studied. It was necessary to heat the 440C steel substrate to 190 degree C to induce decomposition of the fluid. The degradation of the fluid was indicated by the formation of a debris layer at the interface. This debris layer, composed of inorganic and organic reaction products, when completely formed, passivated the surface from further attack to the Fromblin on top. The tribologically induced reactions on 440C steel formed a debris layer of similar chemical characteristics to the thermally induced layer. In all cases, the degradation reaction resulted in preferential consumption of the difluoroformyl carbon (-OCF2O-). Author (revised)

N93-22579# Oak Ridge National Lab., TN.

DEVELOPMENT OF AN INTERFACIAL TEST SYSTEM FOR THE DETERMINATION OF INTERFACIAL PROPERTIES IN FIBER REINFORCED CERAMIC COMPOSITES

A. A. Wereszczak, M. K. Ferber, and R. A. Lowden 1993 15 p Presented at the 17th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 11-15 Jan. 1993

(Contract DE-AC05-84OR-21400)

(DE93-006743; CONF-930164-5) Avail: CASI HC A03/MF A01

In fiber-reinforced ceramic composites, a critical need exists for the accurate measurement of interfacial properties such as the debond strength, sliding shear stress, and residual stress. The characterization of these properties frequently relies on the use of indentation techniques and their instrumentation which may suffer from one or more of the following: insufficient load capabilities, lack of automation, the indentor used produces plastic deformation or worse fiber fracture, and/or inability to conduct tests on fibers whose diameter may be as small as 10-12 micron. The development of an interfacial test system at ORNL represents a concerted effort at addressing these limitations. A description of the hardware and a brief test methodology is presented in addition to a discussion of two test cases. DOE

N93-22690# Oak Ridge National Lab., TN.

FACTORS INFLUENCING THE THERMAL SHOCK BEHAVIOR OF CERAMICS

P. F. Becher and W. H. Warwick 1992 12 p Presented at the International Conference of Thermal Shock and Thermal Fatigue Behavior of Advanced Ceramics, Schloss-Ringberg, Germany, 9-13 Nov. 1992

(Contract DE-AC05-84OR-21400)

(DE93-005762; CONF-9211157-2) Avail: CASI HC A03/MF A01

Application of ceramics requires resistance to tensile stresses from steep thermal gradients. Among popular test techniques to evaluate thermal stress/shock resistance is the down-quench test where the strength retained is determined after quenching. When the temperature difference is sufficient to cause loss in strength, this temperature difference represents the critical temperature drop, Delta-Tc. The thermal shock resistance becomes greater as Delta-Tc increases. However, heat conduction within the sample during quenching results in temperature (and surface tensile stresses) gradients that are less in thin samples as compared to thick samples. In fact, the Delta-Tc values for a given material will decrease and then reach or approach a constant value with increase in sample thickness. Increases in fracture toughness and thermal conductivity yield significant increases in Delta-Tc values in SiC whisker-reinforced alumina versus unreinforced alumina. Changes in the thermal shock damage from large cracks in alumina to a high density of microcracks in zirconia toughened alumina composites are indicated as one source of their improved thermal shock resistance. DOE

N93-22713# Nebraska Univ., Lincoln. Dept. of Electrical Engineering.

CONDUCTIVE PAINTS

R. J. Soukup and N. J. Ianno 1992 7 p

(Contract DE-FG01-92CE-15974)

(DE93-006511; DOE/CE-15974/T2) Avail: CASI HC A02/MF A01

Electrical resistivity measurements require uniformly thick, pinhole-free,

smooth films. A paint preparation and deposition procedure was developed. Adhesion strength was measured on silica and glass substrates. Electrical resistivity was also measured on SiO2 coated Si wafers. DOE

N93-22718# Oak Ridge National Lab., TN.
STRENGTH OPTIMIZATION THROUGH POWDER MODIFICATION
A. E. Pasto, F. Avella (GTE Labs., Inc., Waltham, MA.), S. Natansohn (GTE Labs., Inc., Waltham, MA.), and W. J. Rourke (Duracell, Inc., Needham, MA.) 1992 9 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005109; CONF-921101-16) Avail: CASI HC A02/MF A01

Effect of oxygen content of silicon nitride powders on properties of resulting ceramics was studied by physically and chemically treating the powder to modify its surface oxygen content. These powders were hot-pressed into dense ceramics. Strength and oxidation resistance of these ceramics were measured and correlated with the powder and ceramics compositions as well as the resulting intergranular phases. Results showed that the phases developed in yttria-containing silicon nitride ceramics varied with slight changes in the initial powder oxygen content, as predicted, and that strength could be correlated to initial oxygen concentration. Best results were obtained when the oxygen content was increased by thermal oxidation. A Taguchi Methods experimental study designed to optimize the thermal treatment resulted in silicon nitride ceramics with strength improvements of 22 and 37 percent at ambient temperature and 1370 C, respectively, as compared to untreated powders. Oxidation resistance was also improved. DOE

N93-22729# Akron Univ., OH. Inst. of Polymer Science.
COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH ELASTOMERS
G. R. Hamed and R. H. Seiple Jan. 1993 290 p
(Contract DE-FG02-91CE-23810)
(DE93-007808; DOE/CE-23810/8D) Avail: CASI HC A13/MF A03

The information contained in this report is designed to assist the air-conditioning and refrigeration industry in the selection of suitable elastomeric gasket and seal materials that will prove useful in various refrigerant and refrigeration lubricant environments. 97 percent of the swell measurements have been made to date. The other 3 percent of the measurements are contingent on availability of additional R-32. Swell behavior in the fluids have been determined using weight and in situ diameter measurements for the refrigerants and weight, diameter and thickness measurements for the lubricants. Weight and diameter measurements are repeated after 2 and 24 hours for samples removed from the refrigerant test fluids and 24 hours after removal from the lubricants. DOE

N93-22730# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Chemical Engineering.
PRESSURE-INDUCED AMORPHIZATIONS OF SILICA ANALOGUES: A PROBE OF THE RELATIONSHIP BETWEEN ORDER AND DISORDER
W. S. Hammack Feb. 1993 4 p
(Contract DE-FG02-92ER-45474)
(DE93-007966; DOE/ER-45474/1) Avail: CASI HC A01/MF A01

The purpose of these high pressure investigations is to determine the relationship between order and disorder in amorphous materials using high pressure techniques. Cornell High Energy Synchrotron Source (CHESS) at Ithaca was used to measure x-ray diffraction patterns using Energy-Dispersive X-ray Diffraction. It was shown that the structural ordering in pressure-amorphized solids can be described as defects in curved-space. High-resolution transmissions electron microscopy showed that pressure-amorphized alpha-quartz lacks periodicity at the atomic level. Study of a silicate mineral shows that pressure-induced amorphizations occur because of an impeded phase transition. DOE

N93-22884# Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA.
MATERIALS COMPATIBILITY AND LUBRICANTS RESEARCH ON CFC-REFRIGERANT SUBSTITUTES
G. C. Hourahan and S. R. Szymurski Oct. 1992 11 p
(Contract DE-FG02-91CE-23810)
(DE93-006426; DOE/CE-23810/4) Avail: CASI HC A03/MF A01

The Materials Compatibility and Lubricants Research (MCLR) program supports critical research to accelerate the introduction of CFC-refrigerant substitutes. The MCLR program addresses refrigerant and lubricant properties and materials compatibility. The primary elements of the work include data collection and dissemination, materials compatibility testing, and methods development. The work is guided by an Advisory Committee consisting of technical experts from the refrigeration and air-conditioning industry and government agencies. Under the current MCLR pregrain the Air-Conditioning and Refrigeration Technology Institute, Inc., (ARTI) is contracting and managing several research projects and a data collection and dissemination effort. Preliminary results from these projects are reported in technical progress reports prepared by each researcher. DOE

N93-22885# Trane Co., LaCrosse, WI.
COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH MOTOR MATERIALS
R. Doerr and S. Kujak Oct. 1992 29 p
(Contract DE-FG02-91CE-23810)
(DE93-006428; DOE/CE-23810/4B) Avail: CASI HC A03/MF A01

During the compatibility study of 10 pure refrigerants with 24 motor materials, it was observed that the greatest damage to the insulation system was caused by absorption of refrigerant followed by rapid desorption. The observed effects were blisters, cracking, internal bubbles and delamination. Measured results include decreased bond strength, dielectric strength and overall integrity of the material. Refrigerants HCFC-22, HFC-32, HFC-134 and HFC-152a exhibited this phenomena. The effect of HCFC-22 was most severe of the tested refrigerants. Since HCFC-22 has an excellent reliability history with many of the materials tested, compatibility with the new refrigerants is expected. DOE

N93-22889# Boston Univ., MA. Dept. of Chemistry.
PHOTOINDUCED ELECTRON TRANSFER IN ORDERED POLYMERS
G. Jones, II Jan. 1993 14 p
(Contract DE-FG02-88ER-13905)
(DE93-006784; DOE/ER-13905/5) Avail: CASI HC A03/MF A01

The present report gives a brief account of the following elements of work related to photochemical electron transfer themes: (1) the synthesis and photochemical characterization of chromophore-bound peptides and amino acid model compounds based on the amino acids, tryptophan and the spacer residue, alanine (Ala); (2) the study of binding of cationic organic dyes to a peptide electrolyte, for which cooperative dye loading and helix formation is important; (3) the completion of work on a new series of acridinium chromophores that have 'rod-like' arrangements of linked aryl rings for assembly of electron donor-acceptor systems that exhibit long lived charge separation; and (4) use of the modified form of the peptide, poly-L-histidine, as a template for sulfide oxidation. DOE

N93-22909# Brookhaven National Lab., Upton, NY.
TESTS OF HERCULES/ULTRAMET CVD COATINGS IN HOT HYDROGEN
P. E. Vanier, R. E. Barletta, J. Svandrlik, and J. Adams 1992 12 p
(Contract DE-AC02-76CH-00016)
(DE93-005533; BNL-47965) Avail: CASI HC A03/MF A01

The effort by Hercules and Ultramet to produce CVD NbC coatings, which protect carbon-carbon substrates from hot hydrogen, has had some success but with some limitations. The coatings increase the survival time at atmospheric pressure and low flow rate of hydrogen by about a factor of 40 over uncoated graphite at 3000 K. However, the grain structure is not stable at these temperatures, and after about 10-20 minutes, the coating is subject to rapid degradation by spalling in visible chunks. Further experiments would have to be performed to determine the effects of higher pressures and flow rates, for it is not clear how these factors would affect the survival time, considering that one of the main failure mechanisms is independent of the atmosphere. DOE

N93-22915# Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA.
MATERIALS COMPATIBILITY AND LUBRICANTS RESEARCH ON CFC-REFRIGERANT SUBSTITUTES

G. C. Hourahan and S. R. Szymurski Jan. 1993 31 p
(Contract DE-FG02-91CE-23810)
(DE93-007806; DOE/CE-23810/8) Avail: CASI HC A03/MF A01

The materials Compatibility and Lubricants Research (MCLR) program supports critical research to accelerate the introduction of CFC-refrigerant substitutes. The MCLR program addresses refrigerant and lubricant properties and materials compatibility. The primary elements of the work include data collection and dissemination, materials compatibility testing, and methods development. The work is guided by an Advisory committee consisting of technical experts from the refrigeration and air-conditioning industry and government agencies. Under the current MCLR program the Air-Conditioning and Refrigeration Technology Institute, Inc., (ARTI) is contracting and managing multiple research projects and a data collection and dissemination effort. Preliminary results from these projects are reported in technical progress reports prepared by each researcher. DOE

N93-22918# Texas Univ., Arlington. Center for Advanced Polymer Research.
ELECTRONIC AND IONIC TRANSPORT IN PROCESSABLE CONDUCTING POLYMERS Final Report, 1 Oct. 1989 - 30 Sep. 1992
Martin Pomerantz, John R. Reynolds (Florida Univ., Gainesville.), Krishnan Rajeshwar, and Dennis S. Marynick 11 Jan. 1993 10 p
(Contract N00014-90-J-1320)
(AD-A260223; TR-40) Avail: CASI HC A02/MF A01

Major results along with publications are presented. Some results noted include preparation and study of a low band-gap transparent conducting polymer, poly(1,4-bis(2-heteroaryl) p-phenylenes), electroactive transition metal containing polymers, and conducting polymer composites. In addition, many studies dealing with ion transport upon redox switching of these electroactive polymers were carried out and new probes to monitor these ion fluxes were developed. A highly efficient polypyrrole platinum nano-composite, with useful catalytic properties was also developed. Accurate theoretical and computational techniques, along with a modified Extended Huckel band structure procedure, were developed. GRA

N93-22947# Wayne State Univ., Detroit, MI. Inst. for Manufacturing Research.
THERMAL DIFFUSIVITY MEASUREMENT OF DIAMOND MATERIALS
L Wei, P. K. Kuo, and R. L. Thomas 1992 4 p
(Contract DAAL03-92-G-0246)
(AD-A260431; ARO-28780.5-MS) Avail: CASI HC A01/MF A01

The thermal wave/mirage effect technique is applied to the determination of thermal properties of polycrystalline diamond slabs and single crystal diamonds of different isotopic compositions. This method is well-suited for these kind of materials. GRA

N93-22954# Sandia National Labs., Albuquerque, NM.
CHARGE TRAPPING CENTERS IN FERROELECTRIC CERAMICS
C. H. Seager, W. L. Warren, B. A. Tuttle, R. D. Nasby, and D. Dimos 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Manafgement Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005359; SAND-92-1542C; CONF-921101-24) Avail: CASI HC A02/MF A01

Electron paramagnetic resonance (EPR), photo-thermal deflection spectroscopy (PDS), and electrical measurements were used to characterize as-received and UV-lluminated lead lanthanum zirconate titanate (PLZT) and PZT ceramics. Following optical illumination we observe the activation of positively charged Pb(+3) and negatively charged Ti(+3) ions, as well as an increased broad absorption peak around 2.6 eV. The spatial distribution of the induced absorption correlates well with the location of the absorbed UV, suggesting that photo-produced carrier pairs are trapped at Ti(+4) and Pb(+2) producing the observed paramagnetism. The Ti(+3) EPR spectra were successfully fit using the crystal field parameters derived from the PDS spectra. Preliminary results suggest that these charged paramagnetic ions can influence the electrical properties of PZT thin films. We investigated the effects of UV light and dc bias sequences by polarization-electric field (PE) measurements and find that the coercive fields are dependent on the sign of the applied bias during UV exposure. It is reasonable to expect that Pb(+3) and/or Ti(+3) ions act as the charge trapping sites which cause the threshold voltage shifts in the PE loop. DOE

N93-23006# Helsinki Univ. of Technology, Espoo (Finland). Semiconductor Lab.
ELECTRICAL CHARACTERIZATION OF CONDUCTING POLYMERS AND POLYMERIC SEMICONDUCTOR DEVICES Ph.D. Thesis
Eero Punkka Helsinki, Finland Finnish Academy of Technology 1991 34 p Sponsored by Academy of Finland, Technical Research Centre of Finland, Tekniikan Edistaetaemissaeaetioe, Neste Oy, A. Kordelin Foundation, and O. Oeflund Foundation
(Acta-Pol-Scand-Ph-178; ISBN-951-666-342-7; ETN-93-93475) Avail: CASI HC A03/MF A01

Electrically conducting polymers were characterized by transport measurements and by utilizing polymeric semiconductor devices. The temperature and electric field dependences of the conductivity indicate that the transport mechanism changes from variable range hopping between localized states in undoped poly(3-alkylthiophenes) to charging energy limited tunneling between highly conducting islands in the doped polymer. The experiments yield detailed quantitative information on the electrical conduction processes and the structural homogeneity of the poly(3-alkylthiophenes) processed to free standing films, polymer blends, spin cast films, and Langmuir-Blodgett films. Field effect transistors, Schottky diodes, and metal insulator semiconductor structures were also fabricated using thin films of poly(3-alkylthiophene) and polypyrrole as active semiconductive components. Important parameters, such as the charge carrier mobility, dopant concentration, and the height and width of a rectifying barrier are extracted from the device characteristics. The device configurations are further utilized in the dopant profiling of novel molecular heterostructures. ESA

N93-23025# Allied-Signal Aerospace Co., Kansas City, MO.
STATISTICAL PROCESS CONTROL PROGRAM AT A CERAMICS VENDOR FACILITY
G. M. Enke Dec. 1992 35 p
(Contract DE-AC04-76DP-00613)
(DE93-006043; KCP-613-4866) Avail: CASI HC A03/MF A01

Development of a statistical process control (SPC) program at a ceramics vendor location was deemed necessary to improve product quality, reduce manufacturing flowtime, and reduce quality costs borne by Allied-Signal Inc., Kansas City Division (KCD), and the vendor. Because of the lack of available KCD manpower and the required time schedule for the project, it was necessary for the SPC program to be implemented by an external contractor. Approximately a year after the program had been installed, the original baseline was reviewed so that the success of the project could be determined. DOE

N93-23119# Research and Productivity Council, Fredericton (New Brunswick).
FRACTOGRAPHY APPLIED TO POLYMERIC MATERIALS. PART 9: CREEP AND RUPTURE ANALYSIS
P. Chan and A. B. Mitchell Oct. 1991 70 p
(Contracts DSS-W770700893; DSS-OSC-90-00047-(009))
(DREA-CR-91-470; CTN-93-60699) Avail: CASI HC A04/MF A01

Selected mathematical functions were applied to creep data previously obtained at 25 C for polymethyl methacrylate (PMMA), polyvinyl chloride (PVC), and polyethylene (PE), and their applicability was assessed. Nonlinear regression analysis was used to demonstrate that polynomial and parabolic functions gave the best overall fit for modelling PMMA creep behavior, parabolic and exponential functions for PVC creep behavior, and parabolic and polynomial logarithmic functions for PE creep behavior. The time-stress superposition principle was used to construct master curves for the secondary creep of all three polymers. Log-log relationships between initial stress and master curve shift factor were established to facilitate extrapolation of the master curves to other stress levels. Linear relationships for semi-log and log-log plots of stress versus time to rupture and time to initiation of tertiary creep were demonstrated for PMMA and PVC. These polymers differed from PE, for which a linear relationship between stress and time to rupture (or time to initiation of tertiary creep) appeared to hold. Author (CISTI)

N93-23121# Jay-Em Ceramics, Brampton (Ontario).
DEVELOPMENT OF FIRE PROTECTIVE COATINGS FOR GRP COMPOSITES USING PLASMA DEPOSITION TECHNOLOGY, PHASE 2 Final Report
S. Johar Jul. 1991 70 p
(Contract DSS-W7707-9-1164)
(DREA-CR-91-453) Avail: CASI HC A04/MF A01

Plasma spray technology was developed for applying ceramic based coatings (alumina and zirconia) onto glass reinforced polymeric materials (GRP's). The effect of surface preparation on the adhesion of the coating was examined, and the failure of coating adhesion was evaluated qualitatively. Surface preparation by grit blasting as normally used for plasma spraying of metal and ceramic substrates was found to be unsuitable for obtaining adherent coatings on GRP's. Chemical etching just prior to grit blasting at moderate to low pressure was found to give the desired results. The failure of coating bonding initiated either from glass fiber/coating interface or due to the presence of significant carbon buildup. The adhesive strength of the coating decreases with increasing thickness, most probably due to buildup of thermal stresses in the coating. Phenolic based GRP's were found to be most suitable for developing plasma sprayed coating. The fire protective properties of the coatings were also studied; in most cases the coated materials showed significant improvement in fire protection. Author

N93-23323# Pacific Northwest Lab., Richland, WA.
NEW METHODS AND INSTRUMENTATION FOR THE CHARACTERIZATION OF BIOPOLYMERS USING ELECTROSPRAY IONIZATION-MASS SPECTROMETRY
R. D. Smith, H. R. Udseth, A. L. Rockwood, B. E. Winger, S. A. Hofstadler, D. R. Goodlett, and K. J. Light-Wahl Sep. 1992 3 p Presented at the Mass Spectrometry Society of Japan, Japanese Society for Biomedical Mass Spectrometry Conference, Osaka, Japan, 20-24 Sep. 1992
(Contract DE-AC06-76RL-01830)
(DE93-005100; PNL-SA-20758; CONF-9209283-1) Avail: CASI HC A01/MF A01

The technique of electrospray ionization (ESI) has significantly extended the ability to characterize large molecules by mass spectrometry. Proteins to at least 200,000 D can be transferred intact to the gas phase and molecular weights determined with precisions as high as 0.001 percent if individual charge states can be resolved. The ESI-MS can also serve as a near ideal interface and detector for capillary column separations providing a basis for highly efficient sample utilization. Using capillary electrophoresis (CE)-MS, injection quantities in the 10(sup -18) mole range can be detected for smaller polypeptides using selected ion monitoring, and separation efficiencies as high as 5 x 10(exp 5) theoretical plates have been realized. We have recently shown that the use of small 5 micrometer i.d. capillaries allows CE-MS with scanning detection for proteins for injection of 600 attomoles. DOE

N93-23365# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
SPUTTER ION PLATING ON Ti6AlV4 AND Ti(cp): PREPARATION AND PROPERTIES OF OXIDATION AND WEAR RESISTANT COATINGS
Meinhard Meyer, Richard Suchentrunk, Horst E. Franz, B. Mathes (Technische Univ., Darmstadt, Germany.), and E. Broszeit (Technische Univ., Darmstadt, Germany.) 1992 10 p Presented at 7th World Conference in Titanium (TMS), San Diego, CA, 28 Jun. - 2 Jul. 1992 Sponsored by BMFT
(MBB-Z-0444-92-PUB; ETN-93-93445) Avail: CASI HC A02/MF A01

The application of sputter ion plating as a versatile deposition technique is described. Coatings deposited in such a way help avoid surface embrittlement and crack initiation as a consequence of oxygen penetration and dissolution. Titanium Ti6Al4V and Ti(cp), were coated with Al, Ni, NiCR, Cr and Cr2N. Nickel and aluminum form titanium intermetallics rapidly, while chromium and Cr2N do not. Crack propagation during 3 point bending tests was observed in differently coated Ti6AlAV in the scanning electron microscope. The results which give information on the mechanical behavior of the thin layers are provided. The wear tests in a plate-on-cylinder tribometer show a large decrease of wear if the titanium plates were coated by a PVD/galvanic deposition. ESA

N93-23725# McMaster Univ., Hamilton (Ontario). Dept. of Materials Science and Engineering.
DIELECTRIC AND DYNAMIC MECHANICAL PROPERTIES OF ATBN-CONTAINING THERMOSETS
G. P. Johari Aug. 1991 98 p
(Contract DSS-W7707-0-1026/01-OSC)
(DREA-CR-91-444; CTN-93-60662) Avail: CASI HC A05/MF A02

Five epoxy-based thermoset composites containing up to 61.4 percent by weight of amine terminated butadiene acrylonitrile (ATBN) elastomer were prepared by prescribed thermal treatments. The thermoset consisted of a rigid matrix of diglicydyl ether of bisphenol-A which was cured with Versamid 125 or Ancamide 260A. Curing kinetics of samples of each of the ATBN/epoxy blends were monitored using dielectric measurements for a fixed frequency of 1 kHz. The dielectric properties of the cured samples were measured over the 77-350 K temperature range. The data obtained from this and an earlier study were interpreted and discussed with reference to the literature. A detailed dielectric study of pure ATBN, pure thermoset and ATBN-containing thermosets during their sol to gel glass transformation and phase separation in the sol states shows time dependent changes that can be understood in terms of the direct current conductivity, orientation polarization, and liquid-liquid phase separation. The sub-transition temperature dynamic mechanical relaxation of ATBN-containing thermosets is mainly due to the glass-rubber or alpha relaxation process of the ATBN, whose peak appears at a temperature and frequency near the gamma relaxation peak of the pure thermoset. The rate of curing becomes slower with increased amount of ATBN in the thermoset. Author (CISTI)

N93-23949# Calm (James M.), Great Falls, VA.
ARTI REFRIGERANT DATABASE
James M. Calm Nov. 1992 94 p Prepared in cooperation with Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA
(Contract DE-FG02-91CE-23810)
(DE93-006431; DOE/CE-23810/4E) Avail: CASI HC A05/MF A01

The database provides bibliographic citations and abstracts for publications that may be useful in research and design of air-conditioning and refrigeration equipment. The database identifies sources of specific information on R-32, R-123, R-124, R-125, R-134, R-134a, R-141b, R-142b, R-143a, R-152a, R-245ca, R-290 (propane), R-717 (ammonia), ethers, and others as well as azeotropic and zeotropic and zeotropic blends of these fluids. It addresses lubricants including alkylbenzene, polyalkylene glycol, ester, and other synthetics as well as mineral oils. It also references documents on compatibility of refrigerants and lubricants with metals, plastics, elastomers, motor insulation, and other materials used in refrigerant circuits. A computerized version is available that includes retrieval software. DOE

N93-23957# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
A GEL-PERMEATION CHROMATOGRAPHY STUDY OF ELECTROCHEMICALLY SYNTHESIZED POLY(3-ALKYLTHIOPHENES) Technical Report, 31 May 1991 - 30 Jun. 1992
Y. Wei and J. Tian 26 Jun. 1992 14 p
(Contract N00014-90-J-1559)
(AD-A259864; TR-1992-38) Avail: CASI HC A03/MF A01

Poly(3-n-pentylthiophene) and poly(3-n-hexylthiophene) were prepared using potentiostatic method and were characterized by gel-permeation chromatography (g.p.c.) in THF. In general, the molecular weight of the polymers increased as the applied potential was increased in the range of 1.3 to 1.7 V vs. SCE. The presence of 2,2'-bithiophene in the polymerization system resulted in a slight decrease in molecular weight but the polymer chains having higher regularity as evidenced by longer pi-conjugation length. At the potentials greater than 1.9 V, the molecular weight decreased because of polymer degradation. The results strongly support the electrophilic aromatic substitution mechanism for electrochemical polymerization of thiophene monomers. GRA

N93-23974# Argonne National Lab., IL.
THERMALLY INDUCED MICROMECHANICAL STRESSES IN CERAMIC/CERAMIC COMPOSITES
Zhuang Li and R. C. Bradt (Nevada Univ., Reno.) Nov. 1992 14 p Presented at the International Conference of Thermal Shock and Thermal Fatigue Behavior of Advanced Ceramics, Schloss-Ringberg, Germany, 9-13 Nov. 1992

(Contract W-31-109-eng-38)
(DE93-004860; ANL/MSD/CP-78152; CONF-9211157-1) Avail: CASI HC A03/MF A01

The internal micromechanical stresses which develop in ceramic-ceramic composites as a consequence of temperature changes and thermoelastic property differences between the reinforcing and matrix phases are addressed by the Eshelby method. Results for two whisker reinforced ceramic matrix composites and for quartz particles in porcelain are discussed. It is concluded that the stresses which develop in the second phase reinforcing inclusions are quite substantial (GPa-levels) and may be highly anisotropic in character. These stresses are additive to the macroscopic thermal stresses from temperature gradients which are encountered during heating and cooling, and also to externally applied mechanical stresses (loads). These micromechanical stresses are expected to be highly significant for thermal cycling fatigue and other failure processes. DOE

N93-23975# Argonne National Lab., IL.
BOUNDARY FILM FOR STRUCTURAL CERAMIC MATERIALS
O. O. Ajayi, A. Erdemir, J. H. Hsieh, R. A. Erck, G. R. Fenske, and F. A. Nichols May 1992 22 p Presented at the 9th International Conference of Wear of Materials, San Francisco, CA, 13-17 Apr. 1993
(Contract W-31-109-eng-38)
(DE93-004871; ANL/CP-75342; CONF-930414-3) Avail: CASI HC A03/MF A01

Structural ceramic materials, like metals, will require lubrication if they are to be used extensively for tribological applications. The use of thin soft metallic coatings (specifically Ag) as a boundary film during mineral oil lubrication of silicon nitride (Si3N4) and zirconia (ZrO2) ceramic materials was investigated in this study. With a pin-on-flat contact configuration in reciprocating sliding, the steady friction coefficient was reduced by a factor of 2 (0.14-0.16 vs. 0.06-0.07) when the flats were coated with Ag. Also, with Ag coatings the wear of pins was reduced to an unmeasurable level, whereas, in the absence of Ag coatings specific wear rates of approx 2 x 10(sup -9) - 4 x 10(sup -8) mm(sup 3)/Nm and approx 7 x 10(sup -8) - 2 x 10(sup -7) mm(sup 3)/Nm were measured for Si3N4 and ZrO2 pins respectively. In addition to preventing direct contact between pins and flats, thereby reducing wear, the Ag coatings also act as a solid lubricant, help dissipate flash heating, and accelerate modification of the (lambda) ratio. DOE

N93-24033# Oak Ridge National Lab., TN.
TEXTURED COATINGS FROM COLLOIDAL SUSPENSIONS OF FACETED OXIDE MICROCRYSTALS
G. W. Steadman, J. R. Brewster, J. D. Budai, and L. A. Boatner 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-006601; CONF-921101-80) Avail: CASI HC A02/MF A01

The morphological properties of cubic, faceted MgO microcrystals have been exploited in the formation of textured coatings. Coatings exhibiting a (100) 'fiber' texture were formed by centrifugal sedimentation of colloidal suspensions onto a flat substrate. A decrease in the degree of preferred orientation in the coatings with increasing areal coverage of the particles was quantified for several particle-size distributions by using x-ray diffraction. Novel methods for the deposition of particles exhibiting an in-plane preferred orientation in addition to fiber texture have been investigated. DOE

N93-24062# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Groupe Solides Mal Ordonnes.
STUDY OF THE ALPHA AND BETA MECHANICAL RELAXATIONS OF PMMA, PS AND THEIR COPOLYMERS Ph.D. Thesis [ETUDE DES RELAXATIONS MECANIQUES ALPHA ET BETA DU PMMA, DU PS ET DE LEURS COPOLYMERS]
Elisabeth Muzeau 1992 223 p In FRENCH
(ISAL-92-0042; ETN-93-93684) Avail: CASI HC A10/MF A03

A study on alpha and beta mechanical relaxations of the amorphous polymers PMMA (Polymethylmethacrylate), PS (Polystyrene), and their copolymers, by low frequency mechanical dynamical spectrometry, which aimed at understanding the relationship between the mechanical properties and the chemical structure of the systems, is presented. PMMA beta relaxation analysis attributed the characteristic time distribution to a very wide distribution of the entropy factor as well as a narrower distribution of the energy factor. Beta relaxation of the copolymers showed two components: the first relates to the MMA units relaxation and its temperature characteristics vary with the composition of the copolymer, while the second is identified with PS beta relaxation. Alpha relaxation of the copolymers showed a single principle relaxation with characteristics somewhere between those of PMMA and PS. PMMA alpha relaxation extends to temperatures as low as the beta field. The alpha relaxation of all the materials was analyzed with the help of a molecular theory. The isothermal physical aging of these systems was studied at temperatures as low as 90C Tg. The physical aging effects on mechanical relaxations showed that only alpha relaxation is affected by this phenomena. Thus it was possible to explain alpha relaxation modifications using the molecular theory. ESA

N93-24073# Texas Univ., Austin. Dept. of Chemical Engineering.
ELECTRON DIFFUSION COEFFICIENTS IN HYDROGELS FORMED OF CROSS-LINKED REDOX POLYMERS Technical Report, Oct. 1992 - Jan. 1993
Atsushi Aoki and Adam Heller 26 Jan. 1993 22 p Sponsored in part by NIH and the Welch Foundation
(AD-A260163; TR-002) Avail: CASI HC A03/MF A01

The electron diffusion coefficient (D(sub e)) for the redox polymer POs-EA, an ethylamine quaternized poly(vinylpyridine) complex of Os(bipyridine)2Cl2, was directly measured by steady-state voltammetry at interdigitated array (IDA) electrodes. In cross-linked POs-EA D(sub e) decreased upon increasing the ionic strength and upon changing the hydrophilic chloride counterion to the hydrophobic perchlorate anion. In 5.0 wt percent cross-linked POs-EA, D(sub e) is pH dependent increasing from 4.5 x 10(exp -9) to 1.6 x 10(exp -8) cm(sup 2)/sec as the pyridine rings are protonated. In highly (25 wt percent) cross-linked POs-EA, the motion of the chains is restricted, D(sub e) is independent of pH. The results show that D (sub e) increases steeply upon hydration of POs-EA. It is proposed that the extent of electron diffusion in redox hydrogel is determined by segmental motion of the polymer backbone and is therefore enhanced, rather than diminished upon swelling of the redox polymer network, that increases the static distances between redox centers. GRA

N93-24116# Morris Brown Coll., Atlanta, GA.
PROCESSABLE PRECURSORS TO HIGH PERFORMANCE LIQUID CRYSTALLINE POLYMERS Final Report, 1990 - 1992
I. I. Harruna Oct. 1992 5 p
(Contract DAAL03-90-G-0190)
(AD-A260466; ARO-28093.2-CH-SAH) Avail: CASI HC A01/MF A01

Processable precursor polymers to aramids, poly(imino 1,4-phenyleneiminocarbonyl-1,4 phenylenecarbonyl) and poly(imino 1,3-phenyleneiminocarbonyl 1,4-phynelenecarbonyl), were prepared and studied. The precursor polymers were made from the reaction of 2,5-dichlorobicyclo (2.2.2)octane 1,4-dicarbonyl chloride or 2,5-diacetoxybicyclo (2.2.2)octane-1,4-dicarboxylic acid. The polymeric precursors were subsequently converted in approximately 98 percent - 100 percent yields, via dehydrohalogenation and retro Diels-Alder reactions to the corresponding aramids by refluxing in 1M solution of potassium hydroxide or sodium hydroxide, or by bulk pyrolysis using aromatization catalysts, such as, ZnCl2 and dichlorobenzene sulfonic acid. Only the p-phenylene precursor polymer exhibited liquid crystal characteristics in solution. Thermal properties were examined and tensile properties will be determined in a future study. GRA

N93-24142# Brown Univ., Providence, RI.
BASIC RESEARCH ON MACROMOLECULAR DYNAMICS Annual Report, 1 Sep. 1991 - 31 Aug. 1992
J. H. Weiner Sep. 1992 45 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5091-260-2237)
(PB93-138907; GRI-92/0442) Avail: CASI HC A03/MF A01

Work in this past year has focused on the computer simulation of the viscoelastic behavior of dense polymer melts with the goal of clarifying the role of the excluded volume (EV) interactions in the production of stress. The widely-held classical viewpoint is that EV makes only an isotropic contribution to the stress and that the anisotropic part of the stress is transmitted through the covalently-bound chains acting as entropic springs. By contrast, our simulations show that EV interactions are primarily

responsible for the anisotropic stress throughout the relaxation process. Initial simulations were performed using idealized chain models. This past year simulations were performed with chain models of increasing realism. The basic conclusion concerning the unexpected role of EV remained unchanged. GRA

N93-24154# Texas Univ., Austin. Dept. of Chemical Engineering.
ELECTRON CONDUCTING ADDUCTS OF WATER-SOLUBLE REDOX POLYELECTROLYTES AND ENZYMES Technical Report No. 1, Oct. 1992 - Jan. 1993
Ioanis Katakis, Mark Vreeke, Ling Ye, Atsushi Aoki, and Adam Heller 26 Jan. 1993 39 p LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(AD-A259938) Avail: CASI HC A03/MF A01

Biochemical fluxes were transduced to electrical currents through catalytic centers of oxidoreductases, that were electrically connected to electrodes with crosslinked hydrogel forming redox polymers. The enzymes were covalently bound to the hydrogels through which the electrons diffuse. The electron diffusion coefficients, reaching 10(exp -8) cm(exp 2)sec(exp -1) in the redox polymer gels, were high enough to allow efficient collection of the electrons transferred during the electrooxidation or electroreduction of substrates. The adequate electron diffusion through the polymer skeleton of the hydrogel and the rapid diffusion of water-soluble substrates and products in the gels led to high current density enzyme electrodes. These included electrodes with electrically connected flavoenzymes (e.g. sarcosine, glutamate, lactate and glucose oxidases), quinoprotein enzymes (e.g. PQQ glucose dehydrogenase) and heme enzymes (e.g. peroxidases). The peroxidase electrodes are useful in the sensing of NAD(P)H, that catalytically reacts with oxygen in the presence of N-methyl phenazonium salts to form NAD(P)+ and H2O2. GRA

N93-24170# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
THE STUDY OF POLYETHER SOLVATION MECHANISMS USING UV/VISIBLE SPECTROSCOPY Technical Report, 31 May 1991 - 30 Jun. 1992
M. Mendolia, H. Cai, and G. C. Farrington 12 Jun. 1992 53 p
(Contract N00014-90-J-1559)
(AD-A260355; Rept-1992-26) Avail: CASI HC A04/MF A01

It is demonstrated that UV/Visible spectroscopy is a very useful technique for learning about the coordination of certain transition metal ions in polymer electrolytes. The results demonstrate unequivocally that complex ions exist in polymer electrolytes of this sort, particularly at moderate to high salt concentrations and at elevated temperatures. Furthermore, it appears that free anions and anionic complex species are the predominant charge carriers in the electrolytes studied. In fact, the studies indicate that the principal mechanism of cation mobility in Co(II) and Ni(II)-PEG electrolytes is by the motion of complex anions, not the diffusion of uncomplexed cations. GRA

N93-24193# North Carolina Univ., Chapel Hill. Dept. of Geology.
CRYSTAL CHEMISTRY OF CERAMIC/MINERAL SYSTEMS Final Report, 1 Nov. 1988 - 31 Aug. 1992
Robert R. Reeber 8 Dec. 1992 4 p
(Contract DAAL03-89-C-0002)
(AD-A260440; ARO-26246.3-MS) Avail: CASI HC A01/MF A01

Crystallochemical and mechanical property relationships of refractory materials were investigated including thermal expansion and the friction and wear of refractory ceramics. Continuous x-ray diffraction techniques as a function of temperature were developed. GRA

N93-24201# California Univ., Riverside.
ULTRAFAST FREQUENCY AGILE OPTICAL MATERIALS: ORGANICALLY DOPED SOL-GEL GLASSES Final Report
Eric L. Chronister 14 Oct. 1992 19 p
(Contract DAAL03-89-G-0095)
(AD-A260525; ARO-27185.5-MS-SM) Avail: CASI HC A03/MF A01

This report focuses on organically doped sol-gel glasses as novel fast response photochromic materials. In particular, we discuss time-resolved spectroscopic measurements of the following: (1) nanosecond optical energy transfer in organically doped glasses; (2) investigation of the spatial distribution of chromophores within the porous sol-gel matrix; (3) homogeneous dephasing of optically excited states as a probe of chromophore-host interactions; (4) time-resolved anisotropy measurements as a probe of chromophore dynamics in porous sol-gel matrices; and (5) optical limiting based on fast photophysical processes of organic chromophores. Optical energy transfer in organically doped sol-gel glasses is investigated by time-resolved fluorescence depolarization measurements. We observe nanosecond optical energy transfer and analyze these results in terms of the spatial distribution of chromophores in doped porous xerogel glasses. Time-resolved polarized emission results are also used to probe the rotational dynamics of chromophores during the fabrication process from solution to gel to porous glass. Furthermore, picosecond photon echo measurements have been used to obtain the homogeneous dephasing rate of organic dopants in an inorganic sol-gel glass, as a means of probing chromophore-host environment. GRA

N93-24221# Department of the Navy, Washington, DC.
METHOD FOR BONDING A POLYURETHANE MOLDING COMPOSITION TO A CABLE JACKET OF AN OLEFIN/ESTER INTERPOLYMER Patent Application
Thomas S. Ramotowski, inventor (to Navy) 23 Sep. 1992 19 p
(AD-D015627; US-Patent-Appl-SN-948561; Navy-Case-73940) Avail: CASI HC A03/MF A01

A room temperature curing polyurethane composition is bonded to the surface of cables having jackets of an olefin/ester interpolymer to provide a water resistant seal thereabout by first exposing the surface of a length of cable to an alkali metal hydroxide solution to hydrolyze the functional ester groups and thereby substitute hydroxyl groups for the organic acid of the ester in the interpolymer at the surface of the jacket. A diisocyanate primer is applied to the treated surface and it interacts with the hydroxyl groups to produce pendant reactive groups. A room temperature curing urethane prepolymer composition is then molded about the primed surface at ambient temperatures and the unreacted hydroxyl groups along the urethane prepolymer chain react with the pendant reactive groups of the jacket to produce a firmly bonded overmolding on the jacket. GRA

N93-24229# Department of the Navy, Washington, DC.
PLASMA TREATMENT OF GLASS SURFACES Patent Application
Jasbinder Sanghera, inventor (to Navy) and Pablo Pureza, inventor (to Navy) 30 Sep. 1992 19 p
(AD-D015619; US-Patent-Appl-SN-953390; Navy-Case-73865) Avail: CASI HC A03/MF A01

Glass free of surface carbon deposits, such as carbon film and/or carbon occlusions, and a process for removing such carbon deposits from glass. The process is characterized by the application of a plasma to glass to remove the carbon deposits. The plasma used for this purpose contains active specie which reacts with the carbon deposits to form gaseous carbon products. GRA

N93-24257# Department of the Navy, Washington, DC.
PREPARATION OF PERMANENT PHOTOWRITTEN OPTICAL DIFFRACTION GRATINGS IN IRRADIATED GLASSES Patent Application
Glen M. Williams, inventor (to Navy), David A. Dutt, inventor (to Navy), Jacqueline A. Ruller, inventor (to Navy), and Edward J. Frevels, inventor (to Navy) 30 Oct. 1992 20 p
(AD-D015623; US-Patent-Appl-SN-968872; Navy-Case-74035) Avail: CASI HC A03/MF A01

A fast process for photowriting a permanent, high efficiency optical grating comprises darkening glass by irradiation and photobleaching the darkened glass by exposing the glass to interfering writing laser beams, thereby forming the grating. GRA

N93-24290# National Research Council of Canada, Boucherville (Quebec). Industrial Materials Inst.
PERFORMANCE STUDY OF THE RHEOMETRICS MELT FLOW MONITOR FOR REAL-TIME RHEOLOGICAL CHARACTERIZATION [ETUDE DE LA PERFORMANCE DU MELT FLOW MONITOR (RHEOMETRICS) POUR CARACTERISATION RHEOLOGIQUE EN TEMPS REEL]
Karim Amellal Mar. 1992 165 p In FRENCH; In ENGLISH and FRENCH
(NRC-34372; IMI92RT-32200-1369-G; CTN-93-60708) Avail: CASI HC A08/MF A02

The Rheometrics Melt Flow Monitor (MFM) is designed to be mounted between the output of a polymer extruder and the die by means of an adapter. In operation, a small quantity of melted polymer is deviated from the main flow leaving the extruder and fed in a controlled, pressure isolated manner through the monitor by means of independently operating inlet and outlet pumps. The two pumps control the flowrate of melted polymer through an opening in the MFM while temperature and pressure sensors control the flow conditions of the melted polymer. The MFM is intended to measure the real-time viscosity of melted polymer during the extrusion process, as well as other rheological characteristics. Tests were conducted on polypropylene 6631 to verify the validity of the data treatment performed in the MFM and the reproducibility of results, to evaluate the precision of the results, to study certain aspects of MFM operation, and to evaluate the effectiveness of the MFM in terms of control of extrusion parameters. The MFM was found capable of generating reproducible and reliable results. Shear stress sweeping at 30-second delay was found to offer a better precision in rheological results than a shear rate sweep at 100 second delay, but at a longer test duration. The method of determination of activation energy from MFM data was also found very reliable. CISTI

N93-24300# Cambridge Univ. (England).
FIRST EUROPEAN TRI-SERVICE ADVANCED MATERIALS WORKSHOP: COMPRESSIVE STRENGTH IN RIGID-ROD POLYMERS Final Report
2 Dec. 1992 18 p
(Contract DAJA45-92-M-0268)
(AD-A259997; R/D-6951-MS-03) Avail: CASI HC A03/MF A01

The Workshop began with an intriguing and provocative presentation of experimental work on model LC polymer systems which emphasized the importance of chain segregation according to chain length. The morphological studies set the stage for much debate on molecular origins of compressive failure. A review of Du Pont research on strategies for possible improvement in compressive strength in rigid-rod polymers was presented. GRA

N93-24321# Chemical Research and Development Center, Aberdeen Proving Ground, MD.
SOLID-STATE (31)P MAGIC ANGLE SPINNING (MAS) NMR STUDY OF THE PARTITIONING AND REACTION OF ORGANOPHOSPHORUS ESTERS ADSORBED ON SYNTHETIC RESIN CATALYSTS Final Report, Feb. - Aug. 1991
William T. Beaudry, George W. Wagner, and J. R. Ward Sep. 1992 22 p
(DA Proj. 101-61102-A-71-A)
(AD-A259889; CRDEC-TR-419) Avail: CASI HC A03/MF A01

A powder containing sorptive and reactive resins that was developed for the removal and subsequent catalytic degradation of toxic organophosphorus esters is characterized using dimethyl methylphosphonate (DMMP), p-nitrophenyl diphenyl phosphate (PNDP), and P-31 MAS NMR. The results for DMMP confirm, spectroscopically, that adsorbed ester partitions between the sorptive and reactive resin components. Spectra of the DMMP surface probe adsorbed on the resin are indicative of two different adsorption sites, one possessing a much larger capacity compared to the other. The large capacity site in assigned to the reactive resins, and the smaller capacity site is assigned to the sorptive carbonaceous resin. Variable temperature P-31 MAS NMR results for DMMP demonstrate that any molecular exchange between these sites must be occurring at a rate less than 300/s, even at 50 C. The PNDP hydrolyzes on the resin powder to yield diphenyl phosphate (DPP) and p-nitrophenoxide. GRA

N93-24330# Oak Ridge National Lab., TN.
APPLICATION OF MICROWAVE HEATING FOR FABRICATION OF SILICON NITRIDE CERAMICS
Terry N. Tiegs, James O. Kiggans, and Kristin L. Ploetz 1993 13 p
Presented at the 17th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 11-15 Jan. 1993
(Contract DE-AC05-84OR-21400)
(DE93-006741; CONF-930164-7) Avail: CASI HC A03/MF A01

Microwave processing of silicon nitride-based ceramics was examined to identify aspects that would have advantages over conventional heating such as improved fabrication parameters or increased mechanical properties. Areas of microwave processing examined were sintering of powder compacts and sintering of reaction-bonded silicon nitride. The sintering of powder compacts showed improved densification and enhanced grain growth. However, the high additive levels required to produce crack-free parts generally limit these materials to low temperature applications. Sintered reaction-bonded silicon nitride materials were fabricated in the microwave with a one-step process using cost-effective raw materials. The materials had properties appropriate for structural applications. DOE

N93-24408# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
ORGANOSILICON COMPOUNDS AND POLYMERS AND SILICON CERAMICS Final Report, 1 Nov. 1988 - 31 Dec. 1992
Dietmar Seyferth 23 Nov. 1992 15 p
(Grant AF-AFOSR-0040-89)
(AD-A260056; AFOSR-92-1015TR) Avail: CASI HC A03/MF A01

A three-year summary of the principal investigator's research on organosilicon chemistry directed toward ceramics synthesis is discussed. GRA

N93-24417# Cincinnati Univ., OH.
USE OF BLOCK COPOLYMER AS POLYMER BLEND COMPATIBILIZER Final Report, 1 Feb. 1989 - 31 Oct. 1992
R. J. Roe 30 Jan. 1993 13 p
(Contract DAAL03-89-K-0040)
(AD-A260435; ARO-26579.3-MS) Avail: CASI HC A03/MF A01

Mechanical properties of polymer blends can be improved by addition of block copolymers as compatibilizers. The objective of this study has been to systematically investigate the effect of an added block copolymer in order to gain understanding of the factors, such as the amount, size, and structure of block copolymer, that control the efficacy of the compatibilization. The rate of particle coarsening that occur at the late stage of phase separation has been shown to be affected sensitively by the presence of even a very small amount of block copolymer. On the assumption that the late stage proceeds by the Lipshitz-Slyozov mechanism, one can estimate the change in the interfacial tension resulting from the adsorption of block copolymer at the interface. The larger the block copolymer size is, the more pronounced is the reduction in the particle coarsening rate. When polymers are melt-blended, a larger block copolymer additive is again found to be more effective than smaller copolymers. GRA

N93-24419# Cornell Univ., Ithaca, NY. Dept. of Materials Science and Engineering.
ION BEAM MODIFICATION OF CERAMICS: MECHANICAL PROPERTIES AND STRUCTURE Final Report, 1 Sep. 1989 - 14 Oct. 1992
Timothy E. Levine and James W. Mayer 12 Jan. 1993 3 p
(Contract DAAL03-89-K-0154)
(AD-A260504; ARO-26806.6-MS) Avail: CASI HC A01/MF A01

The objective of this work was to study tribomechanical property changes. The changes were brought about by ion beam induced materials modification of the tribomechanical properties of ceramics. GRA

N93-24436# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
LUMINESCENCE AND PICOSECOND PHOTO-INDUCED ABSORPTION OF POLYANILINE Technical Report, 31 May 1991 - 30 Jun. 1992
K. Kim, L. B. Lin, J. M. Ginder, T. L. Gustafson, and A. J. Epstein 29 Jun. 1992 8 p
(Contract N00014-90-J-1559)
(AD-A260002; Rept-1992-4) Avail: CASI HC A02/MF A01

The photoluminescence and photoinduced absorption are reported for leucoemeraldine and emeraldine forms of polyaniline in the picosecond to nanosecond time domain. The importance of bond vibration, charge tunneling, and ring rotations in varying relaxation processes is determined. The temperature dependence of the photoluminescence decay time of the leucoemeraldine base dissolved in N-methyl pyrrolidinone is reported. The decay time decreases as the temperature increases. From the Arrhenius plot, the activation energy is estimated to be approx. 0.1 eV. These data suggest that backbone vibrations dominate this photoluminescence decay mechanism. From the comparison of the result to that of the monomer, aniline, it is concluded that a polaron-exciton confined in the basic unit including a ring and adjacent nitrogen atoms is responsible for the photoluminescence. The picosecond photoinduced absorption of emeraldine base films optically pumped at 2.1 eV and probed at 1.5 eV and 2.9 eV are compared with the previously measured picosecond photoinduced

bleaching probed at 2.0 eV. While all three of them show initial fast decay, the photoinduced absorption at 1.5 eV does not show a substantial residue on the nanosecond time scale. This is in contrast to the photoinduced bleaching at 2.0 eV and 2.9 eV photoinduced absorption for which more than half of the signal remains even after a few nanoseconds. Preliminary measurements of emeraldine base films at a probe energy of 2.9 eV indicate that the decay slows down when the temperature is lowered. For emeraldine base in N-methyl pyrrolidinone solution, this long lived tail in picosecond photoinduced absorption disappears. These data strongly suggest the importance of the ring-torsion. GRA

N93-24443# Pennsylvania Univ., Philadelphia.
OPTICAL AND MAGNETIC SIGNATURES OF LOCALIZED EXCITATIONS IN PERNIGRANILINE: ROLE OF NEUTRAL SOLITONS
Technical Report, 31 May 1991 - 30 Jun. 1992
W. P. Su and A. J. Epstein 29 Jun. 1992 21 p
(Contract N00014-90-J-1559)
(AD-A260001; Rept-1992-50) Avail: CASI HC A03/MF A01

Using a tight-binding Hamiltonian, we study the Peierls distorted form of polyaniline, the pernigraniline base (PNB) polymer. Both bond order and ring torsional degrees of freedom are considered in the conformational relaxation. The geometrical and electronic structures of the localized solitonic and polaronic excitations are calculated. Comparison with available optical and magnetic measurements is made. Particular emphasis is placed on the spectroscopic and magnetic features of neutral solitons. GRA

N93-24445# Los Alamos National Lab., NM.
CHEMICAL VAPOR INFILTRATION WITH MICROWAVE HEATING
D. J. Devlin, R. P. Currier, R. S. Barbero, and B. F. Espinoza 1992 7 p Presented at the 17th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 11-15 Jan. 1993
(Contract W-7405-eng-36)
(DE93-005458; LA-UR-92-4391; CONF-930164-2) Avail: CASI HC A02/MF A01

The use of microwave energy to heat substrates during chemical vapor infiltration (CVI) is described. Both numerical predictions and experimentally observed thermal profiles indicate that steep inverted thermal gradients can be established in fibrous preforms subjected to microwave radiation. When combined with the CVI technique, the inverted gradients can be exploited to promote inside-out densification. Recent microwave assisted CVI results, which focus on silicon based matrix materials, are described. Emphasis is placed on the role played by the relative ability of fiber and matrix to dissipate microwave energy. Issues central to further process development, such as the effect of interfacial coating on subsequent microwave processing, are discussed. DOE

N93-24461# Argonne National Lab., IL.
OBTAINING HIGH-RESOLUTION IMAGES OF CERAMIC FROM 3-D X-RAY MICROTOMOGRAPHY BY REGION-OF-INTEREST RECONSTRUCTION
E. A. Sivers, D. A. Holloway, and W. A. Ellingson 1992 11 p Presented at the 17th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 11-15 Jan. 1993
(Contract W-31-109-eng-38)
(DE93-006796; ANL/MCT/CP-77181; CONF-930164-9) Avail: CASI HC A03/MF A01

3-D x-Ray imaging technology, when applied to advanced ceramics, is limited in some cases by detector sensitivity. This limitation can be overcome to some degree by the use of region-of-interest (ROI) reconstruction software. We have developed such software and applied it to 28 mm-diameter, injection-molded Si3N with known hole-type defects ranging in diameter from 25.4 to 508 microns. We have also applied the ROI concept to large (22 cm)-diameter Si3N4 turbocharger rotors, demonstrating the ability to resolve only the critical blade-hub region for each blade. DOE

N93-24474*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
BETA CLOTH DURABILITY ASSESSMENT FOR SPACE STATION FREEDOM (SSF) MULTI-LAYER INSULATION (MLI) BLANKET COVERS
Steven L. Koontz, Stephen Jacobs, and Julie Le (McDonnell-Douglas Corp., Houston, TX.) Mar. 1993 30 p
(NASA-TM-104748; S-669; NAS 1.15:104748) Avail: CASI HC A03/MF A01

MLI blankets for the Space Station Freedom (SSF) must comply with general program requirements and recommendations for long life and durability in the low-Earth orbit (LEO) environment. Atomic oxygen and solar ultraviolet/vacuum ultraviolet are the most important factors in the SSF natural environment which affect materials life. Two types of Beta cloth (Teflon coated woven glass fabric), which had been proposed as MLI blanket covers, were tested for long-term durability in the LEO environment. General resistance to atomic oxygen attack and permeation were evaluated in the high velocity atomic oxygen beam system at Los Alamos National Laboratories. Long-term exposure to the LEO environment was simulated in the laboratory using a radio frequency oxygen plasma asher. The plasma asher treated Beta cloth specimens were tested for thermo-optical properties and mechanical durability. Space exposure data from the Long Duration Exposure Facility and the Intelsat Solar Array Coupon were also used in the durability assessment. Beta cloth fabricated to Rockwell specification MBO 135-027 (Chemglas 250) was shown to have acceptable durability for general use as an MLI blanket cover material in the LEO environment while Sheldahl G414500 should be used only in locations which are protected from direct Ram atomic oxygen. Author

N93-24500# Los Alamos National Lab., NM.
MAGNETIC RESPONSE OF CERTAIN CURVED GRAPHITIC GEOMETRIES
L. Wang, P. S. Davids, A. Saxena, and A. R. Bishop 1992 7 p Presented at the 1992 International Conference on Science and Technology of Synthetic Metals, Goeteborg, Sweden, 12-18 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003694; LA-UR-92-3232; CONF-9208132-5) Avail: CASI HC A02/MF A01

The quasi-particle energy spectra associated with some members of buckyfamily (curved graphitic geometries), in particular C50, C60, C70, and related fullerenes as well as coaxial helical microtubules of graphite, are obtained analytically within the mean-field approximation. These energy spectra are then used to calculate various response functions. Specifically, we calculate the specific heat, magnetization, and magnetic susceptibility in the presence of an external magnetic field at low temperatures. For a single microtubule an extra peak superimposed on the first de Haas van Alphen (dHvA) oscillation in magnetic susceptibility is found in the 50-170 Tesla range depending on the radius which is possibly accessible in special (explosive flux compression) experiments. Finally, we point to important potential applications of these novel mesoscopic structures in nanotechnology. DOE

N93-24506# Spauschus Associates, Inc., Atlanta, GA.
SOLUBILITY, VISCOSITY AND DENSITY OF REFRIGERANT/LUBRICANT MIXTURES
D. R. Henderson Jan. 1993 16 p
(Contract DE-FG02-91CE-23810)
(DE93-007809; DOE/CE-23810/8F) Avail: CASI HC A03/MF A01

This report presents results on low refrigerant concentration (70, 80, 90, and 100 weight percent lubricant) mixtures of the following fluids: CFC-12/ISO 32 naphthenic mineral oil; HCFC-22/ISO 32 naphthenic mineral oil; and HFC-134a/ISO 32 pentaerythritol ester mixed acid. These data have been reduced to engineering form and are presented in the form of a Daniel Chart. Scatter diagrams are given for the first fluid listed above, with the intent of illustrating the quality of data as well as providing the rationale for selecting the particular functional forms chosen to represent the experimental data. Equations are given along with statistical measures of goodness of fit. DOE

N93-24507# Imagination Resources, Inc., Dublin, OH.
COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH ENGINEERING PLASTICS
R. C. Cavestri Jan. 1993 71 p
(Contract DE-FG02-91CE-23810)
(DE93-007826; DOE/CE-23810/8E) Avail: CASI HC A04/MF A01

Seven oil immersion studies were completed at both 20 and 60 C. Test bars used in this study fall within the manufacturer specification limits of physical consistency and integrity. Refrigerant Immersion studies at ambient and 60 C are also complete. Equilibrium refrigerant gas solubilities

of the 32 ISO VG branched acid polyolester with all ten refrigerants have been determined and completed at 20 C. Finally, the thermal aging of plastics at constant refrigerant pressure exposure with seventeen refrigerant lubricant combinations was completed. DOE

N93-22117*# Lockheed Missiles and Space Co., Sunnyvale, CA.
RIGID FIBROUS CERAMICS FOR ENTRY SYSTEMS
Ronald P. Banas *In* NASA. Langley Research Center, Space Transportation Materials and Structures Technology Workshop. Volume 2: Proceedings Feb. 1993 p 431-436 (For primary document see N93-22081 08-16)
Avail: CASI HC A02/MF A04

N93-22182*# Army Belvoir Research and Development Center, Fort Belvoir, VA.
RUST TRANSFORMATION/RUST COMPATIBLE PRIMERS
Dario A. Emeric and Christopher E. Miller *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 317-323 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-23946 Department of National Defence, Ottawa (Ontario). Polymeric Materials and Textiles Lab.
AN OVERVIEW OF MATERIALS TESTING IN DND Abstract Only
A. Savard, B. Guilmette, and S. Lee *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 151 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N93-22325# Department of Energy, Washington, DC. Office of Domestic and International Energy Policy.
ASSESSMENT OF COSTS AND BENEFITS OF FLEXIBLE AND ALTERNATIVE FUEL USE IN THE US TRANSPORTATION SECTOR
Oct. 1992 165 p
(DE93-004659; DOE/EP-0003P) Avail: CASI HC A08/MF A02

As part of its Alternative Fuels Assessment, the US DOE is studying the use of compressed natural gas (CNG), methanol, and other derivatives of natural gas as alternative transportation fuels. The cost and most likely sources of new, uncommitted natural gas supply are determined. Natural gas reserves in 32 countries are reviewed in detail. The results of the resource cost calculations for the countries are reported. DOE

N93-22424# Sandia National Labs., Albuquerque, NM.
SOLAR REFORMING APPLICATIONS STUDY SUMMARY
I. Spiewak (Weizmann Inst. of Science, Rehovoth, Israel.), C. Tyner, and U. Langnickel (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) 1992 14 p Presented at the 6th International Symposium on Solar Thermal Concentrating Technologies, Mojacar, Spain, 25 Sep. - 2 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE93-002286; SAND-92-2189C; CONF-920938-5) Avail: CASI HC A03/MF A01

Research in recent years has demonstrated the efficient use of solar thermal energy for driving endothermic chemical reforming reactions in which hydrocarbons are reacted to form syngas. Closed-loop reforming/methanation systems can be used for storage and transport of process heat and for short-term storage for peaking power generation. Open-loop reforming and gasification systems can be used for direct fuel production; for production of syngas feedstock for further processing to bulk ammonia, hydrogen, and liquid fuels; and for destruction of hazardous organic materials. To help identify the most promising areas for future development of this technology, we discuss in this paper the market potential of these applications. DOE

N93-22502# Sandia National Labs., Albuquerque, NM.
DEVELOPMENT OF RATE EXPRESSIONS FOR THE THERMAL DECOMPOSITION OF RDX
K. L. Erickson, R. Behrens, Jr. (Sandia National Labs., Livermore, CA.), and S. Bulusu (Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.) 1992 11 p Presented at the 29th JANNAF Combustion Meeting, Hampton, VA, 19-23 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005345; SAND-92-1135C; CONF-9210112-4) Avail: CASI HC A03/MF A01

Decomposition and combustion of energetic materials involve processes in both condensed and gas phases. Development of reliable models for design, performance, stability, and hazard analyses requires detailed understanding of the mechanisms for both the initial condensed phase decomposition of the energetic material and the subsequent reaction of the decomposition species to form the ultimate reaction products. Those mechanisms must be described in terms of constitutive rate expressions that can be incorporated into mathematical models. The thermal decomposition of RDX has been studied by Behrens and Bulusu using Simultaneous Thermogravimetric Modulated Beam Mass Spectrometry (STMBMS). Their work provides a basis for developing some of the constitutive rate expressions that are needed in models for design, performance, stability and hazard analyses involving RDX. Behrens and Bulusu have identified four primary reaction pathways that control the liquid-phase decomposition of RDX at temperatures between 200 and 215 C, and one that controls solid-phase decomposition at temperatures below 200 C. Two of the liquid-phase pathways appear to be first order in RDX. Arrhenius parameters for the first-order rate constants were evaluated from data reported by Behrens and Bulusu. Reaction rates extrapolated to temperatures between 370 and 450 C are in good agreement with global reaction rates observed by Trott et al. using high-speed photography and laser-heated thin-film samples. Furthermore, the STMBMS results of Behrens and Bulusu appear to be consistent with condensed-phase infrared results reported by Trott et al. and Erickson et al. DOE

N93-22929# Midwest Research Inst., Golden, CO.
XYLOSE FERMENTATION TO ETHANOL
J. D. McMillan Jan. 1993 46 p
(Contract DE-AC02-83CH-10093)
(DE93-000067; NREL/TP-421-4944) Avail: CASI HC A03/MF A01

The past several years have seen tremendous progress in the understanding of xylose metabolism and in the identification, characterization, and development of strains with improved xylose fermentation characteristics. A survey of the numerous microorganisms capable of directly fermenting xylose to ethanol indicates that wild-type yeast and recombinant bacteria offer the best overall performance in terms of high yield, final ethanol concentration, and volumetric productivity. The best performing bacteria, yeast, and fungi can achieve yields greater than 0.4 g/g and final ethanol concentrations approaching 5 percent. Productivities remain low for most yeast and particularly for fungi, but volumetric productivities exceeding 1.0 g/L-h have been reported for xylose-fermenting bacteria. In terms of wild-type microorganisms, strains of the yeast Pichia stipitis show the most promise in the short term for direct high-yield fermentation of xylose without byproduct formation. Of the recombinant xylose-fermenting microorganisms developed, recombinant E. coli ATTC 11303 (pLOI297) exhibits the most favorable performance characteristics reported to date. DOE

N93-22968# Technical Research Centre of Finland, Espoo. Polttoainetekniikan Lab.
USE OF NEW OXYGENATES AS GASOLINE COMPONENTS [UUSIEN OKSYGENAATTIEN KAYTTO BENSIINIKOPONENTTEINA]
Nils-Olof Nylund, Matti Kyto, Markku Ikonen, Aimo Rautiola (Neste Oy, Porvoo, Finland.), and Jussi Kokko (Neste Oy, Porvoo, Finland.) 1992 94 p In FINNISH
(DE93-752864; VTT-TIED-1364) Avail: CASI HC A05/MF A01

In addition to conventional hydrocarbons, oxygen-containing component - oxygenates - are generally used in gasoline to replace lead compounds as octane boosters and to reduce exhaust emissions. Such components

are alcohols and ethers, of which methyl tertiary butyl ether (MTBE) is most commonly used. Three gasoline grades were studied experimentally by engine and car tests in the laboratory and by a field test with 20 passenger cars. One of the fuels was a reference gasoline containing solely hydrocarbons, the second one contained 11 percent MTBE and the third one 13 percent ethyl tertiary butyl ether (FTBE). The oxygen content of the oxygenate-containing gasolines was 2 weight-percent. Neither the engine performance measurements nor the field test gave differences in gasoline consumption or engine output. In driveability tests in the laboratory, the oxygenate gasolines were in cold conditions superior to the reference gasoline, while no significant differences were observed in the hot-driveability test. On the basis of the road octane requirement tests, a slightly higher octane number is required for the oxygenated fuels than for the hydrocarbon fuel. When using oxygenated fuels, the CO emission of the non-catalyst cars was reduced by 15-20 percent and the HC emission by about 5 percent. The corresponding reductions for the catalyst cars were 0-10 percent (CO) and about 10 percent (HC). The fuel had no effect on the NO(sub x) emission. At the cold test of 30 min at -20 and +-0 deg C the CO emission of the threeway catalyst engine was reduced on average by 7 percent and the HC emission by 6-11 percent. DOE

N93-23048# Midwest Research Inst., Golden, CO.
BIOFUELS PROGRAM PLAN, FY 1992 - 1996
Jan. 1993 40 p
(Contract DE-AC02-83CH-10093)
(DE93-000036; DOE/CH-10093/186) Avail: CASI HC A03/MF A01

This five-year program plan describes the goals and philosophy of the US Department of Energy's (DOE) Biofuels Systems Division (BSD) program and the BSD's major research and development (R&D) activities for fiscal years (FY) 1992 through 1996. The plan represents a consensus among government and university researchers, fuel and automotive manufacturers, and current and potential users of alternative fuels and fuel additives produced from biomass. It defines the activities that are necessary to produce versatile, domestic, economical, renewable liquid fuels from biomass feedstocks. The BSD program focuses on the production of alternative liquid fuels for transportation--fuels such as ethanol, methanol, biodiesel, and fuel additives for reformulated gasoline. These fuels can be produced from many plant materials and from a significant portion of the wastes generated by municipalities and industry. Together these raw materials and wastes, or feedstocks, are called biomass. DOE

N93-23321# Amoco Oil Co., Naperville, IL. Research and Development Dept.
DIRECT CONVERSION OF LIGHT HYDROCARBON GASES TO LIQUID FUEL
R. D. Kaplan and M. J. Foral 16 May 1992 107 p
(Contract DE-AC22-89PC-89866)
(DE93-004916; DOE/PC-89866/T10) Avail: CASI HC A06/MF A02

Amoco Oil Company has investigated the direct, non-catalytic conversion of light hydrocarbon gases to liquid fuels (particularly methanol) via partial oxidation. The primary hydrocarbon feed used in these studies was natural gas. Work completed in the course of the two-year project is described. In general, the methanol yields delivered by this system were not high enough to make it economically attractive. Process variables studied included hydrocarbon feed composition, oxygen concentration, temperature and pressure effects, residence time, reactor design, and reactor recycle. DOE

N93-23456# Army Research Lab., Aberdeen Proving Ground, MD.
REACTING LIQUID MONOPROPELLANT SPRAYS: EXPERIMENTS WITH HIGH VELOCITY FULL CONE SPRAYS IN 33 MPa, 500 C NITROGEN
Final Report, Feb. 1990 - Feb. 1992
Avi Birk, Michael McQuaid, and Gary Bliesener Dec. 1992 63 p
LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(AD-A259799) Avail: CASI HC A04/MF A01

Experiments were conducted to elucidate the jet breakup, atomization, and combustion of liquid monopropellant sprays through the use of imaging and spectroscopic techniques. Hydroxylammonium nitrate (HAN) based monopropellants LGPI845 and LGPI898 were injected at velocities ranging from 100 to 240 m/s through circular orifices into 33-MPa 500 C nitrogen. Experiments with nitromethane, ethanol, and aqueous HAN and TEAN solutions were also conducted. Spray dynamics were recorded via high-speed cinematography. Breakthroughs in the imaging of combusting sprays were achieved by side illumination of the sprays with pulsed laser light sheets, and by seeding the propellants with nitrate salts of sodium or lithium to enhance flame luminosity. Emission spectroscopy was used to identify combustion intermediates and their relative contribution to color content in the cinematic images. Temperature measurements at the center of the sprays provided additional information regarding spray structures and reactivities. In the experiments reported here, sprays ignite in the far-field and flame advances upstream sustained by extensive turbulent gas recirculation in the closed chamber. The experiments reveal the presence of large liquid drops as well as intense, random burning in vortices. The experiments with nitromethane and ethanol indicate that the dynamic behavior of sprays change when the ambient temperature and pressure exceed critical values. The experimental results are discussed in the context of understanding and modeling spray combustion phenomena in regenerative liquid propellant guns. GRA

N93-23667# Coordinating Research Council, Inc., Atlanta, GA.
1991 CRC OCTANE NUMBER REQUIREMENT SURVEY
Oct. 1992 98 p
(AD-A259821; CRC-580) Avail: CASI HC A05/MF A02

An annual statistical survey of octane number requirements of current model vehicles is conducted by the Coordinating Research Council, Inc. Test data have been obtained by fifteen companies on 262 1991 vehicles including passenger cars and light-duty trucks and vans, of which 105 were equipped with knock sensors. Octane number requirements were determined by testing at maximum-throttle conditions, as well as at part-throttle, with four unleaded fuel series of varying sensitivities, one containing 15 percent methyl tertiary butyl ether. Requirements are expressed as the (R+M)/2 octane number, research octane number, and motor octane number of the reference fuel producing knock which was recurrent and repeatable at the lowest audible level. Estimated octane number requirements for the total vehicles are weighted in proportion to the 1991 vehicle model production and/or sales figures. GRA

N93-24031# Lehigh Univ., Bethlehem, PA.
HIGH OCTANE ETHERS FROM SYNTHESIS GAS-DERIVED ALCOHOLS
K. Klier, R. G. Herman, O. C. Feeley, and M. A. Johansson Oct. 1992 23 p
(Contract DE-AC22-90PC-90044)
(DE93-006476; DOE/PC-90044/8) Avail: CASI HC A03/MF A01

Catalytic testing of inorganic catalysts was continued with the highly active sulfate-modified zirconia catalyst prepared here. Using isobutanol as the only reactant over this catalyst, it was demonstrated that high conversion and selectivity to isobutene was achieved at 175 C. In addition, the high selectivity to isobutene, i.e., 79-86 mol percent, was maintained at higher space velocities and higher temperatures. A high productivity of 11.35 mol isobutene was achieved at 225(degrees)C. Utilizing a methanol/isobutanol = 2/1 molar ratio reactant mixture over the ZrO2/SO4(sup 2-) catalyst, it was shown by a contact time study that the reaction conditions employed here fall in the differential reaction regime. It was found that the isobutene selectivity among the butenes produced hardly varied at a function of contact time and conversion level of isobutanol. Also indicating that the linear 2-butenes are primary products. A separate study showed that the yield of dimethylether increased as the pressure of methanol by itself was increased over the ZrO2/SO4(sup 2-) catalyst, and these yields were higher than those in the presence of isobutanol. A new supported heteropolyacid catalyst was prepared by supporting phosphotungstic acid (H3PW12O40) on silica gel to the level of 20 wt percent. It was shown that the same activities and selectivity patterns were obtained from methanol/isobutanol = 1/1 reactants whether the catalysts were calcined at 100 C or 200 C. It was shown that the activity and selectivity of these catalysts toward isobutene were increased by increasing the reaction temperature. However, under the set of reaction conditions employed, these catalysts were not better than the ZrO2/SO4(sup2-) catalyst. DOE

N93-24044# Arkansas Univ., Fayetteville. Coll. of Engineering.
BIOLOGICAL CONVERSION OF SYNTHESIS GAS
M. D. Ackerson, E. C. Clausen, and J. L. Gaddy 30 Jun. 1992 28 p
(Contract DE-FG21-90MC-27225)
(DE93-006359; DOE/MC-27225/3190) Avail: CASI HC A03/MF A01

Overall mass transfer coefficients for CO have been determined in a

continuous stirred-tank reactor at agitation rates of 300-700 rpm using a biological system with the photosynthetic bacterium Rhodospirillum rubrum. A non-steady state approach was employed in order to separate mass transfer and kinetic limited regions of the fermentation. As a result, a kinetic model could be developed for specific CO uptake by the culture including the apparent CO inhibition. The maximum specific CO uptake rate found matched the earlier results obtained in batch culture and by other investigators. CO inhibition was more predominant in CSTR culture than in batch culture, perhaps due to CO acclimation. The growth of the photosynthetic bacterium Chlorobium thiosulfatophilum on CO2 has been studied at light intensities ranging from 27-1723 lux in batch culture. Modeling results indicate that growth is dependent upon light intensity according to a Monod type relationship. DOE

N93-24332# Dayton Univ. Research Inst., OH.
COMBUSTION AND HEAT TRANSFER STUDIES UTILIZING ADVANCED DIAGNOSTICS: FUELS RESEARCH Final Report, 27 Feb. 1991 - 30 Sep. 1992
D. R. Ballal, R. J. Byrd, S. P. Heneghan, C. R. Martel, and T. F. Williams Nov. 1992 198 p
(Contract F33615-87-C-2767)
(AD-A260249; WL-TR-92-2112) Avail: CASI HC A09/MF A03

As the Air Force continues to advance engine technology, aviation fuel heat loading has steadily increased. Therefore, a thermally stable JP-8 fuel is required that can operate at higher temperatures than current fuels. This research program had two objectives: to identify fundamental conditions of fuel thermal decomposition, and to provide the data needed to develop and evaluate global chemistry and heat transfer models for predicting jet fuel thermal decomposition and deposition rate. We successfully designed and performed numerous static and flowing experiments on a variety of JP fuels. These experiments illuminated the role of antioxidants, peroxides, ketones, and hetero-atom sulfur molecules in the oxidation of surrogate JP-8 and and jet fuels. We developed an autooxidation theory which distinguishes oxidative stability from thermal stability and accounts for the observed oxygen consumption and methane production. Also, we examined several additives and found a select few which produce the least deposits. Finally, our data led to the evaluation and refinement of global chemistry and heat transfer models for predicting jet fuel deposition rates. GRA

N93-24634# Colorado Univ., Boulder. Dept. of Chemical Engineering.
REACTION/SEPARATION PROCESS FOR ENHANCED METHANE CONVERSION Annual Report, Oct. 1991 - Sep. 1992
J. L. Falconer and R. D. Noble Dec. 1992 14 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5090-260-2005)
(PB93-150985; GRI-92/042) Avail: CASI HC A03/MF A01

Temperature and methanol feed rate control were improved by upgrading the apparatus. At low and high temperatures (126 and 205 C), methanol separation factors higher than those predicted by Knudsen diffusion were obtained. A new reactor system that consists of a cold finger located coaxially inside the tubular membrane was built, and partial oxidation of methane over silica supported molebdena catalyst was carried out. At 5-8 percent methane conversion, 35-40 percent methanol selectivity was obtained in the nonisothermal system compared to the 15-20 percent in an isothermal system. Model consisting of mass and mechanical energy balances was formulated and simulated for butane dehydrogenation. Optimal membrane pore diameter of 4-nm, and optimal ratio of inlet innersweep gas flow rate to inlet butane flow rate of 4 were computed for maximum butane conversion. Model consisting of mass balances was formulated for methane partial oxidation to formaldehyde in an inert sweep cocurrent membrane reactor. Optimal membrane reactor performance was not better than the performance of a plug flow reactor under all simulated conditions. GRA

N93-22228*# Sverdrup Technology, Inc., Huntsville, AL.
CARGO TRANSFER VEHICLE RCS PROPELLANT CONTAMINATION ISSUES Abstract Only
Richard O. Ballard *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N93-22038*# Tec-Masters, Inc., Huntsville, AL.
NASA PPO MICROGRAVITY PROJECTS SUPPORT Final Technical Report
Janice F. Smith 15 Jan. 1993 3 p
(Contract NAS8-38778)
(NASA-CR-192460; NAS 1.26:192460; Rept-5508-MN01) Avail: CASI HC A01/MF A01

Work progress is reported in brief. A summary of this information is provided below. An in-depth study was performed to evaluate a new European designed Borack Freezer/Cooler for possible shuttle middeck flight to support advanced protein crystal growth (APCG) experimentation. A statement of work was prepared for the design and development of a glovebox for proposed flight in the shuttle middeck. Work was also initiated to perform an analysis of low-g accelerometer data relative to Fluid Experiment System (FES) experiment options on the IML-1 mission. This work was undertaken in an effort to determine if abnormally low-g accelerations during the mission were responsible for anomalies which occurred during FES/Triglycine Sulfate (TGS) experiment operations. A comprehensive review was made on a revised edition of the Geophysical Fluid Flow Cell (GFFC) Operations and Maintenance (O&M) Manual.
Derived from text

N93-22830# European Space Agency, Paris (France).
FLUIDS IN SPACE
Brigitte Kaldeich, ed. Jun. 1992 587 p In ENGLISH and FRENCH
The 1st symposium was held in Ajaccio, France, 18-22 Nov. 1991
(ESA-SP-353; ISBN-92-9092-254-0; ETN-93-93508) Copyright Avail: CASI HC A25/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The conference was aimed at bringing together 'intentional' microgravity, modeling and ground simulation, and 'involuntary' microgravity, the environment to which engineering must adapt, so that hardware designed for use on the ground can be made to work in space. Papers are presented under the following subheadings: heat and mass transfer; combustion; interface phenomena; polyphase flows; and critical phenomena. Conclusions on these studies are summarized and the need for test facilities for future programs is highlighted. For individual titles, see N93-22831 through N93-22866.

N93-22831# Officine Galileo S.p.A., Florence (Italy).
OPTICAL DIAGNOSTIC FOR HEAT AND MASS TRANSFER IN FLUIDS IN MICROGRAVITY
P. G. Falciani, M. Tacconi, S. Musazzi (Centro Informazioni Studi Esperienze, Milan, Italy.), and U. Perini (Centro Informazioni Studi Esperienze, Milan, Italy.) *In* ESA, Fluids in Space Jun. 1992 p 13-26 (For primary document see N93-22830 08-29)
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An overview of the most powerful optical techniques applicable in space environments is given. Some tracing techniques, for the velocity field visualization, are introduced and, in particular, the photometric method is illustrated. The application of this method to single phase bulk fluids and to a fluid-fluid two phase system are presented. Two techniques were developed both for single point velocity measurements (Laser Doppler Velocimetry (LDV)) and for velocity field measurements (Particle Image Velocimetry (PIV)). The interferometric and holographic techniques for the temperature and concentration fields investigation are treated by looking at their application to microgravity platforms. As an interesting alternative to the above mentioned interferometric techniques, the laser deflectometer is presented. Light scattering techniques for particle size analysis are considered. Particular emphasis is given to low angle light scattering particle sizers. Static and dynamic light scattering techniques are also considered. An all optical ultrasound generation detection system, the LUD (Laser Ultrasound Diagnostic) for the investigation of opaque high temperature fluids is introduced. ESA

N93-22832# Bremen Univ. (Germany). Center of Applied Space Technology and Microgravity.

THE SCIENTIFIC MICROGRAVITY FLUID MECHANICS PROGRAM OF ZARM

Hans J. Rath and Michael Dreyer *In* ESA, Fluids in Space Jun. 1992 p 27-46 (For primary document see N93-22830 08-29)

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The aims of the ZARM program, which is concerned with fluid mechanics research under microgravity, are given together with an overwiew of the program. The microgravity program consists of experimental and theoretical projects. Numerical methods are very important for the validation of experimental results. Furthermore, ZARM is developing modern optical diagnostic systems for applications in microgravity research. At the moment ZARM is reponsible for more than 20 scientific research projects. Research in the areas of microgravity, fluid mechanics, including process technology, combustion, and thermodynamics, and the investigation of the flow of nonnewtonian and multiphase fluids, are the principle areas of interest of ZARM. Most of the experiments can be carried out within a few seconds so the drop tower is an ideal microgravity laboratory for these experiments. A description of the drop tower is given. The scientific goals of the experiments are discussed. These included investigations into the following: elongated viscosity of fluids; simulation of the flow of large scale ocean motions; measurement of heat conductivity in fluids: the influence of gravity on thermal anemometers; polyreactions in microgravity; combustion on free surfaces; and the Weissenberg effect. ESA

N93-22833# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Heat Rejection Section.

ENGINEERING ASPECTS OF TWO-PHASE FLOW SYSTEMS FOR HEAT TRANSPORT **c34**

W. Supper *In its* Fluids in Space Jun. 1992 p 47-59 (For primary document see N93-22830 08-29)

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The basic principles of two phase technology for the thermal management of spacecraft are presented. An overview of ESA activities in this field, namely the development of a mechanically pumped and a capillary pumped two phase heat transport system and the development of a two phase experiment for on orbit demonstration is given. For both the mechanically and capillary pumped two phase loop, a development model was designed, manufactured, and extensively tested. Both systems worked well and the results achieved were promising. ESA

N93-22834# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).

LIQUID DROPLET RADIATOR: DESIGN CONCEPTS AND DEVELOPMENT LOGIC **c31**

Alois Koeppl and Bernhard J. G. Leidinger *In* ESA, Fluids in Space Jun. 1992 p 61-78 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H., Bremen, Germany (For primary document see N93-22830 08-29)

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The results and deduced development logic of an investigation of a Liquid Droplet Radiator (LDR) with a heat rejection capability of 20 kW for aplications in low Earth orbits are presented. Liquid droplet radiators stand out for their efficiency compared to that of conventional radiators. The waste heat is radiated from the cooling fluid directly to the surrounding space. The actual radiator consists of a sheet of droplets of the cooling fluid. The droplets carrying the waste heat emanate from a droplet generator, transfer the waste heat to the space by radiation, and are collected in a droplet collector afterwards. From there the fluid is pumped back, absorbs waste heat in a heat exchanger or cold plate, and returns to the droplet generator. The potential fields of application and the requirements of the LDR are addressed. Details of the droplet generator, droplet sheet and droplet collector are given. A preliminary sizing was performed. ESA

N93-22835# Naples Univ. (Italy). Ist. di Aerodinamica.

NATURAL AND MARANGONI CONVECTION IN TWO SUPERPOSED IMMISCIBLE LIQUID LAYERS WITH HORIZONTAL HEATING **c34**

L. G. Napolitano, A. Viviani, and R. Savino *In* ESA, Fluids in Space Jun. 1992 p 79-108 (For primary document see N93-22830 08-29)

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Thermal Marangoni and natural convection are studied in two superposed immiscible fluid layers enclosed in a shallow rectangular cavity with differentially heated end walls. The horizontal rigid walls are considered either insulated or with a given temperature distribution. The problem was solved via the asymptotic expansions method, by expanding the field variables in power series of the small aspect ratio parameter; both the zeroth and first order approximations are given for each of the boundary conditions in the rigid horizontal walls. The solution is discussed when natural convection prevails in one layer or in both, when there is only Marangoni convection, and, finally, in the case of combined free convection. ESA

N93-22836# Centre National de la Recherche Scientifique, Toulouse (France). Lab. de Genie Chimique et Electrochimie.

CONTINUOUS-FLOW ELECTROPHORESIS: HYDRODYNAMICS, HEAT AND MASS TRANSFER WITH AND WITHOUT GRAVITY

M. J. Clifton and V. Sanchez *In* ESA, Fluids in Space Jun. 1992 p 109-119 Sponsored by CNES (For primary document see N93-22830 08-29)

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Research aimed at the use of microgravity as a suitable environment for studying phenomena of continuous flow electrophoresis in the analysis of biological molecule mixtures without interference from gravitational effects is presented. A model for electrokinetics in electrophoresis is presented. The electrodynamics is investigated. A finite difference technique was used for the hydrodynamic part of the model. The model was used to estimate the behavior of samples containing only one protein at various concentrations. An experimental program in rocket flights is planned. ESA

N93-22837# Imperial Coll. of Science and Technology, London (England).

ELECTRICALLY DRIVEN CONVECTION

Felix Weinberg *In* ESA, Fluids in Space Jun. 1992 p 123-129 (For primary document see N93-22830 08-29)

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A simple, inexpensive, and lightweight method of generating convective flows in gases under microgravity conditions is addressed. It involves the application of large electric fields to ions and other particles present in the gas. Theoretical analysis shows that body forces up to 800 times that due to Earth gravity are attainable. The application of this principle to heat and mass convection is discussed with particular reference to controlling combustion in microgravity environments. Illustrations drawn from the field of combustion, which are likely to find application in microgravity, include manipulating flames, inducting air and fuel, removing hot products, decreasing heat transfer to walls, as well as directing heat flux to surfaces to be heated. ESA

N93-22838# Laboratoire d'Aerothermique du CNRS, Meudon (France).

ACTION OF AN ACCELERATION FIELD ON PREMIXED METHANE/AIR FLAMES [ACTION DU CHAMP D'ACCELERATION SUR LES FLAMMES DE PREMELANGE METHANE/AIR] **c25**

R. Prudhomme and D. Durox *In* ESA, Fluids in Space Jun. 1992 p 131-144 In FRENCH (For primary document see N93-22830 08-29)

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A description of the centrifuge used to produce accelerations up to 200 G is given. This centrifuge was used to study the effect of an acceleration field on the oscillations of premixed methane/air flames. The burner used to produce the flame and the installation used in parabolic flight are described. It was noted that the flame oscillations produced in an acceleration field disappear in microgravity. A law connecting the oscillation frequency with the acceleration field was derived, and mathematical models explaining this derivation are given. ESA

N93-22839# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Materials and Processes Div.

PRACTICAL PROBLEMS RELATED TO FLAMMABILITY AND COMBUSTION IN SPACE **c25**

M. D. Judd *In its* Fluids in Space Jun. 1992 p 145-161 (For primary document see N93-22830 08-29)

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Requirements and tests imposed on materials for use in manned spacecraft are described with particular emphasis on those related to flammability and toxicity. Practical examples are given to illustrate the main problem areas and are related, whenever possible to corresponding data obtained during flight. It is hoped, in this manner, to clarify to the 'scientist' the problems faced by the 'safety engineer' and thus bring about a greater understanding of the need for the various requirements imposed. The currently used flammability tests which are described are: upward propagation test; configuration test; and electrical wire insulation test. Future flammability tests described involve the cone calorimeter, which works on the principle of oxygen depletion measurement (based on the direct relationship between oxygen consumption and heat release), and arc tracking. Flight results are discussed and the test apparatus is described. ESA

N93-22840# Laboratoire d'Aerothermique du CNRS, Meudon (France).

INFLUENCE OF GRAVITY ON POLYEDRIC FLAMES [EFFETS DE LA GRAVITE SUR LES FLAMMES POLYEDRALES] **c25**

D. Durox *In* ESA, Fluids in Space Jun. 1992 p 163-176 In FRENCH (For primary document see N93-22830 08-29)

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Tests carried out during parabolic flight to see the effect of three different levels of gravity, 0, 1, and 1.8 G on propane and air polyedric flames are described and results and conclusions are given. Among other factors, it was found that gravity has a stabilizing effect on flame fronts spreading towards the base even if the front is inclined towards the horizontal. The suppression of natural convection favors long wavelengths; there is in general a loss of facet of the polyhedron at 0 G when the number of facets at 1 G is between 5 and 8. The absence of neutral convection increases the division in temperature between the border and the center of the flame cells (divisions). Photographs of the flames clearly illustrate these divisions. In wide edged flame holders truncations appear at the summit of the pholyhedron in microgravity whereas the flames are polyhedral (or conical) at 1 G. ESA

N93-22841# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).

FLUID MECHANICS APPLICATIONS FOR THE DESIGN AND TEST OF THE SURFACE TENSION TANK OST-2 **c34**

G. Netter (Erno Raumfahrttechnik G.m.b.H., Bremen, Germany.) and M. Dreyer (Bremen Univ., Germany.) *In* ESA, Fluids in Space Jun. 1992 p 179-193 (For primary document see N93-22830 08-29)

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The OST-2 tank, designed to transfer propellant free of bubbles to the thrusters of geostationary satellites, is described. To assure proper functioning of this system, theoretical analyses were performed and the results were compared with associated microgravity experiments. The respective solutions of the Gauss-Laplace equations are presented. The fluid transport within the fundamental elements of the tank, the capillary vanes, and reservoir is described. ESA

N93-22842# MATRA Marconi Space, Toulouse (France).

THE STUDY OF SURFACE TENSION TANKS FROM THE NEUTRAL BUOYANCY TO THE SPACE FLIGHT [L'ETUDE DES RESERVOIRS A TENSION SUPERFICIELLE DE LA FLOTTAISON NEUTRE AU VOL SPATIAL]

Eric Ducret *In* ESA, Fluids in Space Jun. 1992 p 195-211 In FRENCH (For primary document see N93-22830 08-29)

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Tools for studying physical aspects of fluid motion in a new class of Propellant Management Devices (PMD) are described. These PMD's are required to deliver an increased volume of propellant in order to allow the thrusters to operate for longer periods. An experimental bench allows, in balancing gravity by the Archimede's effect, the simulation of a microgravity environment. The difference between the density of the fluids used is controlled by thermal regulation which constrains the study to a steady state acceleration field. A software model takes into account the basic theoretical data, particularly a pressure drop analysis through the vanes and the sponge. It is intended to match this model with the experimental results. This tool calculates two essential parameters, the maximal usable volume and the refilling time of the PMD. To overcome the limitations of software and experimental simulation, a full scale experiment will be carried out on board the Soviet Space Station Mir. It will show the real functioning of the PMD and will eventually allow the updating of the simulation tools on ground. ESA

N93-22843# Aix-Marseilles Univ. (France). Lab. de Thermodynamique.

ADSORPTION KINETICS AT LIQUID-LIQUID INTERFACES IN MICROGRAVITY CONDITIONS. EXPERIMENTAL APPROACH AND THEORETICAL BACKGROUND

F. Ravera, L. Liggieri (Consiglio Nazionale delle Ricerche, Genoa, Italy.), A. Passerone (Consiglio Nazionale delle Ricerche, Genoa, Italy.), and A. Steinchen *In* ESA, Fluids in Space Jun. 1992 p 213-221 Sponsored in part by ESA (For primary document see N93-22830 08-29)

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A method (pressure derivative) for measuring interfacial tension between immiscible fluids phases at zero bond number, was developed. The method is extended to measurements of nonequilibrium interfacial tension and follows the kinetics of diffusion and/or adsorption to the interface, of a surfactant solved in the external phases, in which the drop has been rapidly grown. The development of the experimental procedure to obtain the dynamic interfacial tension from dynamic capillary pressure data is presented. An equation describing the dynamics of the interfacial aging, obtained by considering the adsorption as an extended diffusion process with boundary conditions deduced from microscopic consideration, is presented. This equation allows experimental data to be interpreted, and from this, the molecular activation energies for adsorption and desorption to be deduced. ESA

N93-22844# Bremen Univ. (Germany). Center of Applied Space Technology and Microgravity.

HEAT AND MASS TRANSFER IN POLYPHASE FLOWS **c34**

H. J. Rath and A. Delgado *In* ESA, Fluids in Space Jun. 1992 p 225-243 (For primary document see N93-22830 08-29)

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An overview of problems related to heat and mass transfer in polyphase flows, which play a very important role not only in fluid flow systems under compensated gravity conditions but also in various applications in space technology, is given. On the basis of the governing equations for mass, momentum and energy, different topics are discussed. Problems related to the significance of the presence of gravity in comparison with other forces in polyphase flows are addressed. Dimensionless parameters are indicators of the ratios of such forces. When comparing to the flow of a pure, one phase flow some additional parameters are of importance: concentration, density and viscosity ratios as well as other dimensional groups. The patterns found in polyphase flows depend strongly on the phases involved, their extent and the flow conditions available. Some fundamental research problems in space and under compensated gravity, and examples of applications, are discussed. Investigations of polyphase flows carried out in drop tower are also presented. ESA

N93-22845# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.

RESEARCHES AND DEVELOPMENTS ON TYPICAL THERMAL TECHNOLOGIES FOR SPACE APPLICATIONS **c34**

M. Dubois and S. VanOost *In* ESA, Fluids in Space Jun. 1992 p 245-259 (For primary document see N93-22830 08-29)

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The frame of inhouse or ESA programs, as well other research and development in the field of two phase thermal technologies for space

applications, are presented. An overview of classical heat transport systems used in space thermal control is given and recent results of heat pipes and two phase loops are presented: the development of a so called High Capacity Grooved heat Pipe (HGP), based on the thermal requirements of the new generation of telecommunication satellites, is addressed. The experimental maximum heat transport capability was found near 1500 Wm (horizontally at 20C) for a required 600 Wm while the maximum tilt capability was measured between 15 and 20 mm (at 20C). The test results of an aluminum/ammonia two phase Capillary Pumped Loop (CPL) are shown. This reliable development loop presents a heat transport capability between 250 W and 7.5 kW over a distance of 10 m. A comparative study for CPL evaporator designs is presented and discussed, emphasizing the thermal and hydraulic aspects. Looking for future potential space applications, some guidelines for research and development in two phase thermal technology are described, especially the ESA capillary pumped two phase experiment, which will allow a downscaled version of the CPL to be tested in a microgravity environment. ESA

N93-22846# MATRA Marconi Space, Toulouse (France).
FIRST RESULTS OF A FREON 12 CAPILLARY PUMPED LOOP c34
M. Feuillatre, T. Maciaszek (Centre National d'Etudes Spatiales, Toulouse, France.), C. Butto (Toulouse Univ., France.), V. Platel (Toulouse Univ., France.), J. Y. Grandpeix (Toulouse Univ., France.), and O. Fudym (Toulouse Univ., France.) *In* ESA, Fluids in Space Jun. 1992 p 261-267 (For primary document see N93-22830 08-29)
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The design characteristics, the first experimental data and two thermal mathematical models (FLUINT and ZOOM) of a two phase freon 12 capillary pumped loop are presented. This loop mainly consists of two parallel evaporators and isolators, one condenser, one reservoir (to control the loop temperature), two adiabatic pipes (one for liquid and one for vapor) and instrumentation. Different kinds of cylindrical evaporators are tested. The main design characteristics of the evaporators is an axially grooved profile with a polyethylene wick. Experimental performances already obtained are encouraging (1800 Pa for the capillary pumped pressure with a 10 micron wick). Therefore, heat transport capability up to 750 kW/m can be envisioned for a similar ammonia loop. Up to 5000 W could be transported along an equivalent distance of 150 m (in a 20 mm straight vapor pipe at 20C with a 10 micron wick, neglecting the condenser and liquid return pipe pressure drop). Such a loop, today in development, is also presented. ESA

N93-22847# Technische Univ., Munich (Germany). Lab. for Applied Thermodynamics and Technology Under Microgravity.
BOILING UNDER MICROGRAVITY CONDITIONS
J. Straub, M. Zell, and B. Vogel *In* ESA, Fluids in Space Jun. 1992 p 269-297 Sponsored by BMFT (For primary document see N93-22830 08-29)
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The present state of the art on boiling under microgravity at the various modes of heat transfer such as nuclear boiling, critical heat flux and film boiling, are addressed. The microgravity results are compared to data obtained under the same conditions with Earth gravity. The mechanisms of heat transport are discussed and comments are made in respect to further experimental and theoretical studies under microgravity for a better understanding of the complex boiling process. It is noted that buoyancy acting on the bubbles and buoyancy free convection are not the only dominating mechanisms controlling the heat transfer. The buoyancy can be replaced by other powerful mechanisms that maintain boiling and keep the heat transfer at nearly the same level during nucleate boiling. Most important are the effects caused by the surface tension at the interface, however, the physical reasons behind the process are not yet completely understood and the interpretations made must be regarded as preliminary. ESA

N93-22848# Institut de Mecanique des Fluides de Toulouse (France).
PHYSICAL INTEREST OF TWO-PHASE FLOW EXPERIMENTS AT MICRO-g CONDITION
J. Fabre, C. Colin, and F. Risso *In* ESA, Fluids in Space Jun. 1992 p 299-309 (For primary document see N93-22830 08-29)
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The problems of modeling turbulent two phase gas liquid flow, which must be overcome in order to predict the fields of velocity and void ratio in complex geometries, are illustrated in the case of bubbly flow. These problems are the void ratio distribution by the mean motion of the continuous phase and the turbulent dispersion, and the evolution of interfacial area, in other words of bubble size. These two problems which are the stumbling block of three dimensional two fluid models are discussed in the very simple case of pipe flow. It is shown from a simplified momentum balance and theoretical grounds that microgravity conditions contribute to the understanding of the role of the different forces. The experiments performed up to now at ground or under microgravity conditions are not sufficient enough to be able to isolate each of the afore-mentioned problems. Two basic experiments which will be performed in future parabolic flights are presented. They are: the pipe flow of bubble of given size, and the 'turbulence box' for investigating the breakup or coalescence of bubbles. Some preliminary results obtained in ground experiments on breakup are presented and discussed. ESA

N93-22849# Commissariat a l'Energie Atomique, Grenoble (France). Service de Thermodynamique pour les Applications Industrielles.
FORCED CONVECTION BOILING AND CONDENSATION IN MICROGRAVITY: A CRITICAL APPRAISAL OF THE LITERATURE
J. M. Delhaye and O. Lebaigue *In* ESA, Fluids in Space Jun. 1992 p 311-327 Sponsored by CNES (For primary document see N93-22830 08-29)
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The existing heat transfer correlations for forced convection boiling and condensation are presented with a special emphasis on ammonia as a working fluid. Their application to the available experimental data which were obtained in low gravity is discussed. The following factors are discussed with regard to forced convective boiling in a cylindrical tube: flow patterns, temperature profiles in a heated tube, forced convection in subcooled liquid, onset of nucleate boiling, net vapor generation, suppression of nucleate boiling, boiling crisis. Condensation in both horizontal and vertical tubes is discussed. ESA

N93-22850# L'Air Liquide, Sassenage (France). Advanced Technology Dept.
THERMODYNAMICAL BEHAVIOUR OF SUPERCRITICAL OXYGEN IN THE HERMES SPACEPLANE ENVIRONMENTAL CONDITIONS
P. Bravais *In* ESA, Fluids in Space Jun. 1992 p 331-339 (For primary document see N93-22830 08-29)
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The thermodynamic behavior of the oxygen and hydrogen used by the fuel cell powerplant and the life support systems of the Hermes European Spaceplane is investigated. The oxygen and hydrogen are stored in single state supercritical state. To maintain this state, despite the mass flow depleted from the tanks, the fluids are heated by electrical resistors (a few hundreds of watts) with on/off control to match pressure level. The low conductivity of the fluids and the absence of convection produce gradients greater than 300K over a few centimeters, which can result in hot points and explosion. Moreover, in case of accelerations of the Spaceplane (orbital readjusting or docking), convection appears which causes the mixing of the fluid and a pressure collapse. The latter can be such that the fluid returns to the diphasic state which results in fuel cell failure. Determining the thermodynamic behavior of the fluids and heater support design is accomplished by the use of a computer program which solves the Navier-Stokes and energy equations, using the finite element method. Heat conduction transfer, free and forced convection, radiation and pressure strength work are taken into acount. Equations of state are used for thermodynamic fluid properties due to their large nonlinear variations. ESA

N93-22851# Paris-Sud Univ., Orsay (France). Lab. Fluides, Automatique et Systemes Thermiques.
THE INFLUENCE OF GRAVITY ON THE EQUILIBRIUM AND THE GROWTH OF TENUOUS STRUCTURES

C. Allain, C. Amiel (Centre National de la Recherche Scientifique, Thiais, France.), M. Cloitre, and M. Wafra *In* ESA, Fluids in Space Jun. 1992 p 341-355 (For primary document see N93-22830 08-29)
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The effect of gravity on the equilibrium and the growth of tenuous structures which are encountered in heterogeneous media of condensed matter is dealt with. Percolation and irreversible aggregation models which result in such tenuous structures are reviewed and the different situations which are expected depending on the forces which oppose gravity, to the characteristic times which are involved and the concentration of the medium, are discussed. Experimental results obtained in weakly connected gels where gravity is responsible for a segregation phenomenon and on colloidal dispersions where gravity is observed by induced aggregation, are reported. ESA

N93-22852# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Service de Physique de l'Etat Condense.
HEAT AND MASS TRANSPORT IN A HYPERCOMPRESSIBLE FLUID UNDER ZERO GRAVITY
Y. Garrabos, F. Perrot (Centre National de la Recherche Scientifique, Villetaneuse, France.), and D. Beysens (Centre National de la Recherche Scientifique, Villetaneuse, France.) *In* ESA, Fluids in Space Jun. 1992 p 357-388 Sponsored in part by CNES (For primary document see N93-22830 08-29)
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In order to investigate the different aspects of the transport of heat and mass in the absence of gravity, a thermal cycle is performed close to and around the critical point of CO2 at critical density. A cell was designed which allows surface and bulk phenomena to be distinguished. Special optical devices were used to observe the sample and measure locally temperature and density. Experiments under Earth's gravity a few mK close to the critical temperature (Tc) are presented. They enable convection patterns to be observed and Grashof number as large as 100,000 to be measured. The thermal cycle of the experiment in weightlessness starts at (Tc + 2)mK, where the relaxation of the perturbations caused by liftoff are studied: fluid flows, density and temperature gradients. The effect of a quench from (Tc + 2)mK to (Tc + 1)mK is investigated, and the expected mechanism of heat transport by the Piston Effect (PE) is unambiguously evidenced. In particular, homogeneous thermalization of the sample is observed. A quench at (Tc + 1)mK is performed. The onset of phase separation is observed, making a clear visualization of the PE. Thereafter, spinodal decomposition occurs, followed by the growth of a bicontinuous pattern of gas and liquid domains whose typical scaled wavelength evolves as in density matched critical binary liquids. In addition, rapid density fluctuations are observed whose origin is unclear. After a last quench back to (Tc + 2)mK, the PE is still observed in spite of the presence of density gradients. These gradients are seen to relax by diffusion. ESA

N93-22853# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France). Service de Physique de l'Etat Condense.
PHASE SEPARATION UNDER A WEAK CONCENTRATION GRADIENT **c25**
Y. Jayalakshmi, B. Khalil, and D. Beysens *In* ESA, Fluids in Space Jun. 1992 p 389-403 Sponsored by CNES (For primary document see N93-22830 08-29)
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Phase separation dynamics were studied in a density matched liquid mixture cyclohexane plus deuterated cyclohexane plus methanol in the presence of a weak linear concentration gradient. Concentration gradient is induced by slowly heating the sample from its two phase coexistence below critical temperature (Tc) to one degree above Tc without external agitation. After several hours of mass diffusion smooth concentration profile is formed over the height of the sample. The sample is quenched by pressure into the two phase region within the linear region of the concentation profile. All the quenches are within 3 to 40mK below Tc. The phase separation photos show a central 'fast growth' zone of interconnected structures for concentrations around critical concentration and on either side of the fast zone there is the 'slow growth' zone of isolated droplets. The slow zone width grows in time and saturates at the coexistence width at long time. The major result is that the fast growth zone is of a constant concentration width of 0.018 +/- 0.0025 for all the quench depths. This constant width is in contradiction with the expected boundary at the percolation volume fraction threshold between the coalescence induced and coalescence free growth regimes, but supports the concept of spinodal nucleation. Analysis of the time evolution of the slow zone width agrees with the expected dependence of the initial supersaturation with reduced time in the Langer-Schwartz nucleation theory. The initial width of the slow zone is used to draw the cloud line at the extreme limit of zero observation time. Preliminary light scattering data indicate a clear jump in the value of the growth exponent between the two growth zones. ESA

N93-22854# Centre National de la Recherche Scientifique, Orleans (France). Lab. de Combustion et Systemes Reactifs.
BURNING CHARACTERISTICS OF n-HEPTANE DROPLETS WITH NEGLIGIBLE BUOYANCY EFFECTS **c25**
X. Chesneau, C. Chauveau, and I. Goekalp *In* ESA, Fluids in Space Jun. 1992 p 407-418 Sponsored by ESA and CNRS (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Experimental results concerning the envelope flame burning of n-heptane droplets with negligible buoyancy effects are presented. In order to deduce buoyancy, the parabolic flights of an aircraft are used to create a reduced gravity environment of the order of 0.01 g. The experiments are performed in a droplet burning facility specially designed for this purpose. The results presented give a clear experimental evidence of the nonsteady behavior of droplet burning whereas the spherical summary is conserved by showing essentially that the flame first moves away from the droplet, then back towards it, and that the ratio of flame to droplet diameter increases continuously during combustion. Results from experiments conducted in normal gravity by reduced pressure conditions are compared with low gravity results. Preliminary results on the influence of increasing pressure in drcplet burning in microgravity are presented. ESA

N93-22855# Battelle Inst., Frankfurt am Main (Germany).
OSCILLATIONS OF FINITE LIQUID COLUMNS **c34**
Dieter Langbein *In* ESA, Fluids in Space Jun. 1992 p 419-442 (For primary document see N93-22830 08-29)
(Contract BMFT-QV-8920)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The resonance frequencies of cylindrical liquid bridges spanned between coaxial circular disks are investigated. The oscillations of infinite liquid columns are determined, which are periodic in time but damped in axial direction. For each frequency, an infinite set of such oscillations is obtained. Turning to finite columns, linear combinations of these axially damped oscillations are formed, which satisfy the boundary conditions in the flow velocity at the supporting disks. The resulting infinite sums are truncated by limiting satisfaction of the boundary conditions to a finite number of circles. The pressure exerted by the liquid column into the disks is calculated. The maxima at the resonance frequencies clearly decrease in sharpness and eventually vanish with increasing viscosity and decreasing surface tension of the liquid used. Simultaneously the phase of the pressure decreases from a value close to +pi/2 to a value close to -pi/2. The explicit dependence of the resonance frequencies on the aspect ratio between length and diameter of the liquid columns and their viscosity and surface tension is given. Off resonance, in particular at high frequencies, the length of the columns actually accelerated by the vibrating disk is found to correspond to 30 percent of their diameter. ESA

N93-22856# Naples Univ. (Italy). Ist. di Aerodinamica.
SURFACE TENSION AND BUOYANCY DRIVEN STOKES FLOW IN CAVITIES **c34**
L. G. Napolitano, A. Viviani, and D. Castagnolo *In* ESA, Fluids in Space Jun. 1992 p 443-480 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The motion driven by both surface tension gradients and buoyancy forces in liquids filling a cavity with differentially heated end walls is considered. Under the hypothesis of nondimensional transport numbers (Reynolds and Peclet) and very small capillary number, the field equations

are expanded in a series of successive linear approximations; the zeroth order is the Stokes problem, which is formulated in terms of the stream function and solved analytically via infinite series of the Papkovitch-Fadle complex biorthogonal functions. The solution for the zeroth order temperature, velocity and pressure fields and for the first order free surface shape were derived; since the convergence behavior of the Papkovitch-Fadle series is oscillatory, a convergence study was performed in order to evaluate the number of terms to be retained for a good accuracy. Stream lines, velocity profiles and free surface shapes are given for various aspect ratio of the cavity; in particular, the maximum surface velocity and the maximum free surface deformation are given as function of the aspect ratio. ESA

N93-22857# Institut de Mecanique des Fluides de Marseille (France).
LASER SURFACE TREATMENT: NUMERICAL SIMULATION OF THERMOCAPILLARY FLOW AND FREE SURFACE DEFORMATION **c34**

F. D. Cipriani and A. Roux *In* ESA, Fluids in Space Jun. 1992 p 481-488 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The numerical simulation of thermocapillary flows occurring in laser surface treatment is considered. A two dimensional rectangular cavity is used to model the molten pool which occurs when a laser beam impinges a material. The simulated free surface which is considered deformable (contact angles solid/liquid = 90 deg), is submitted to a sinusoidal temperature distribution (laser beam simulation). The Navier-Stokes and energy equations are solved by a finite element method. The influence of the aspect ratio of the cavity and the capillary number on the free surface shape is investigated. The numerical results are compared with an analytic solution. ESA

N93-22858# Bremen Univ. (Germany). Center of Applied Space Technology and Microgravity.
INVESTIGATION OF HOT WIRE ANEMOMETERS AT VERY LOW VELOCITIES UNDER MICROGRAVITY **c35**

F. R. Stengele, A. Delgado, and H. J. Rath *In* ESA, Fluids in Space Jun. 1992 p 489-500 Sponsored by BMFT (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

A method of calibrating hot wire and hot film probes at very low velocities (Reynolds number greater than 0 and less than 1) under terrestrial conditions as well as under microgravity is reported. With the experimental set up it was possible to investigate all three flow regimes from natural through mixed to forced convection. The investigation showed a significant influence of the free convection for velocities less than 5 cm/s. ESA

N93-22859# Bremen Univ. (Germany). Center of Applied Space Technology and Microgravity.
POLYREACTIONS IN MICROGRAVITY ENVIRONMENT

D. Sturm, R. Mueller, and H. J. Rath *In* ESA, Fluids in Space Jun. 1992 p 501-513 Sponsored by BMFT (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Fundamentals of the reaction mechanism and details of experimental setups for parabolic flight and drop tower are presented. Research was focused on polyreactions and the influence of gravity on molecular weight, polymer dispersity, polymer tacticity, and particle size dispersity. The drop tower was also used to polymerize liquid monomers without containers to study the influence of wall effects on polymerization behavior. The setups were proven to be very suitable, but at the time of publishing they had not been completely evaluated. ESA

N93-22860# Laboratoire d'Aerothermique du CNRS, Meudon (France).
A METHOD OF MEASURING THE INTERFACIAL TENSION OF TWO LIQUIDS OF THE SAME MASS VOLUME: THE CYLINDRICAL METHOD [UNE METHODE DE MESURE DE LA TENSION INTERFACIALE DE DEUX LIQUIDES DE MEME MASS VOLUMIQUE: LA METHODE DU CYLINDRE] **c34**

C. Bisch and I. Martinez (Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain.) *In* ESA, Fluids in Space Jun. 1992 p 517-524 In FRENCH (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

A method for the measurement of the interfacial tension concerning two immiscible liquids of the same density is proposed. This method is based on the measurement of the forces acting on a liquid bridge, in particular a liquid cylinder. The bridge connects the faces of two equal circular discs and is immerged in the second liquid. ESA

N93-22861# Institut National Polytechnique, Grenoble (France). Lab. de Thermodynamique et Physico-Chimie Metallurgiques.
WETTING HYSTERESIS OF TIN ON SILICA SOLID SURFACES OF CONTROLLED PERIODIC ROUGHNESS **c34**

V. DeJonghe and D. Chatain *In* ESA, Fluids in Space Jun. 1992 p 525-532 Sponsored by CNES (For primary document see N93-22830 08-29)
(Grant B/BREU-900307-8)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The wettability of a solid surface with controlled shape features is studied in a liquid Sn/vitreous SiO2 system at 1150 K. The topographical defects of the solid surface are cylinders which have a diameter of 60 micrometers. They are arranged in a hexagonal network which extend above the basal surface. The maximum wetting hysteresis, defined as the difference between the largest advancing and smallest receding contact angles, depends on neither the concentration (9 and 33 percent) nor the height of the defects (33 nm to 1 micrometer). It is measured by a 'compressed drop' method originally derived from the sessile drop method. In situ observations of the motion of the solid-liquid-vapor triple line using hot stage light microscopy show that this line is not pinned at the edge of the cylindrical defects, because the high curvature of the edge of the topographical features differs from the curvature of the triple line. In this case, contact angle hysteresis only depends on the mean roughness and/or heterogeneity of the surface parallel to the plane in which the triple line moves. ESA

N93-22862# Essen Univ. (Germany). Chair of Mechanics.
EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF THE TEMPERATURE GRADIENT ON THE THERMOCAPILLARY CONVECTION IN SPHERICAL DROPS UNDER LOW-GRAVITY

U. Duda, J. A. Szymczyk, J. Siekmann, M. Treuner (Bremen Univ., Germany.), A. Delgado (Bremen Univ., Germany.), and H. J. Rath (Bremen Univ., Germany.) *In* ESA, Fluids in Space Jun. 1992 p 533-545 Sponsored by BMFT (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The investigation of the thermocapillary convection within spherical drops under low gravity conditions using parabolic flight possibilities in a KC-135 aircraft is addressed. Formation and management of large sized drops up to 1 mm in diameter are described. Flow and temperature fields inside the drops were visualized simultaneously by using a white light sheet and liquid crystal tracers. The geometrical and optical setup and the measuring technique as well as evaluated flow data for the temperature and velocity field are demonstrated. ESA

N93-22863# Institut de Mecanique des Fluides de Marseille (France).
HEAT TRANSFER SIMULATION WITH A CONDUCTIVE-RADIATIVE MODEL FOR PREDICTING THE SHAPE OF HgI2 CRYSTAL GROWN IN THE LTVG FURNACE **c76**

A. Roux and A. Fedoseyev (Academy of Sciences, USSR, Moscow.) *In* ESA, Fluids in Space Jun. 1992 p 547-552 (For primary document see N93-22830 08-29)
(Contract ESA-8431/89/F/BZ)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The modeling of heat exchangers in a sealed ampoule in the LTVG furnace is considered in order to compute temperature fields and control the growth of HgI2 crystals from vapor phase at low temperatures. As a first step, a coupled conductive radiative model was used to determine the shape of the crystal at an equilibrium state (i.e., without growth rate). Only one case is considered, corresponding to the end of growth. The model involves conductivity anisotropy in the crystal and radiative exchanges

between grey and diffuse surfaces (source and crystal interfaces, pyrex walls), which are considered as opaque. Internal buoyancy effect is not taken into account as the pressure inside the ampoule is very small. The influence of the imposed boundary conditions, in particular along the pedestal and the cold finger regions which play a crucial role during the growth, was emphasized. The 'equilibrium' isotherm between the source/gas and crystal/gas interfaces, which is associated with the stop of the growing process, was numerically obtained. This 'equilibrium' isotherm gives the crystal shape, which is compared with previous experimental results. The model would permit a better understanding and control of the future HgI2 crystal growth experiment. The computations are performed using a finite element package. ESA

N93-22864# Toulon Univ. (France).
STUDY OF THE INFLUENCE OF THE WETTABILITY OF A WALL ON A THIN FILM [ETUDE DE L'INFLUENCE DE LA MOUILLABILITE DE LA PAROI SUR LA STABILITE D'UN FILM MINCE] c34
P. Seppecher *In* ESA, Fluids in Space Jun. 1992 p 553-568 In FRENCH Sponsored by CNES (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The linear stability of the equilibrium of a thin liquid layer lying on a flat wall was studied. Usually this stability depends upon gravity (Rayleigh-Taylor instability) but not upon wall distance or wetting properties. Using the Cahn and Hilliard model for multiphase fluid, it was shown that the influence of the wall decreases exponentially with the layer thickness and is all the more important as the gravity is weak and the fluid is close to the critical point. ESA

N93-22865# Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German D.R.).
THERMOCAPILLARY INSTABILITIES IN THE PRESENCE OF A HOMOGENEOUS MAGNETIC FIELD
Andre Thess and K. Nitschke *In* ESA, Fluids in Space Jun. 1992 p 569-577 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Theoretical results about the interplay between thermocapillary (Marangoni) instability and a magnetic field under terrestrial and microgravity conditions are presented. A comprehensive treatment is reported of Marangoni instability in an unbounded layer of fluid with a free upper surface. Surface deformation is taken into account. A homogeneous magnetic field acting perpendicular to the free surface gives rise to a postponement of the onset of the instability. If the layer is heated from below, the instability is purely exponentially growing. A fluid layer heated from above becomes unstable with respect to oscillatory perturbations. A comparison between the thresholds of stationary and oscillatory Marangoni instabilities show that the latter is more sensitive to the application of the magnetic field. A qualitative discussion of the instability in a horizontal magnetic field indicates a selective suppression of instability depending upon the orientation of the roll cells to the direction of the magnetic field. ESA

N93-22866# National Aerospace Lab., Emmeloord (Netherlands). Space Div.
THERMAL GRAVITATIONAL MODELLING AND SCALING OF TWO-PHASE HEAT TRANSPORT SYSTEMS: SIMILARITY CONSIDERATIONS AND USEFUL EQUATIONS, PREDICTIONS VERSUS EXPERIMENTAL RESULTS
A. A. M. Delil *In* ESA, Fluids in Space Jun. 1992 p 579-599 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Various aspects of thermal gravitational scaling of spacecraft two phase heat transport systems are reviewed. Supporting similarity considerations, based on dimension analysis, and useful equations and correlations are given. The assessment of the applicability (validity and restrictions) of modeling and scaling approach is supported by a comparison of two phase flow pressure drops measured under low gravity conditions and modeling predictions. Terrestrial scaling experiments with ammonia test rig are identified for the support of the development of the ESA capillary pumped Two Phase ammonia experiment (TPX) in Get Away Special G-557 and the development of the mechanically pumped ESA R114 Two Phase Heat Transport System (TPHTS). ESA

N93-23122*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
STABILITY AND INSTABILITY OF THERMOCAPILLARY CONVECTION IN MODELS OF THE FLOAT-ZONE CRYSTAL-GROWTH PROCESS Final Report, 2 May 1989 - 31 Oct. 1992
G. P. Neitzel Mar. 1993 11 p
(Grant NAG3-1221)
(NASA-CR-192695; NAS 1.26:192695) Avail: CASI HC A03/MF A01

This project was concerned with the determination of conditions of guaranteed stability and instability for thermocapillary convection in a model of the float-zone crystal-growth process. This model, referred to as the half-zone, was studied extensively, both experimentally and theoretically. Our own earlier research determined, using energy-stability theory, sufficient conditions for stability to axisymmetric disturbances. Nearly all results computed were for the case of a liquid with Prandtl Number Pr = 1. Attempts to compute cases for higher Prandtl numbers to allow comparison with the experimental results of other researchers were unsuccessful, but indicated that the condition guaranteeing stability against axisymmetric disturbances would be a value of the Marangoni number (Ma), significantly higher than that at which oscillatory convection was observed experimentally. Thus, additional results were needed to round out the stability picture for this model problem. The research performed under this grant consisted of the following: (1) computation of energy-stability limits for non-axisymmetric disturbances; (2) computation of linear-stability limits for axisymmetric and non-axisymmetric disturbances; (3) numerical simulation of the basic state for half- and full-zones with a deformable free surface; and (4) incorporation of radiation heat transfer into a model energy-stability problem. Each of these is summarized briefly below. Derived from text

N93-23171*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MATERIALS SCIENCE ON PARABOLIC AIRCRAFT: THE FY 1987-1989 KC-135 MICROGRAVITY TEST PROGRAM
Peter A. Curreri, ed. Mar. 1993 143 p
(NASA-TM-4456; M-713; NAS 1.15:4456) Avail: CASI HC A07/MF A02

This document covers research results from the KC-135 Materials Science Program managed by MSFC for the period FY87 through FY89. It follows the previous NASA Technical Memorandum for FY84-86 published in August 1988. This volume contains over 30 reports grouped into eight subject areas covering acceleration levels, space flight hardware, transport and interfacial studies, thermodynamics, containerless processing, welding, melt/crucible interactions, and directional solidification. The KC-135 materials science experiments during FY87-89 accomplished direct science, preparation for space flight experiments, and justification for new experiments in orbit. Author

N93-23179 Princeton Univ., NJ.
DROPLET COMBUSTION CHARACTERISTICS UNDER MICROGRAVITY AND NORMAL-GRAVITY CONDITIONS Ph.D. Thesis
Mun Young Choi 1992 304 p
Avail: Univ. Microfilms Order No. DA9230621

This dissertation examines the effects of relative droplet/gas motion, soot and sootshell formation, intermediate and product absorption and the substitution of various inert (N2, He, Ar) gases on the overall burning characteristic of isolated droplets including quasi-steady and transient combustion. Microgravity experimental results indicate that quiescent burning rates for isolated n-heptane droplets (in air) are substantially lower than the values previously reported by various investigators. Experiments (conducted under normal-gravity and microgravity conditions) have demonstrated that the sooting propensity of n-alkane fuel droplets can be varied through diluent-substitution, oxygen-index variations and ambient pressure reductions. A transient droplet combustion model (CRFM) was used to gain phenomenological insights into the dynamics of sootshell formation. By incorporating empirical scaling corrections that account for observed reductions in droplet burning rate and flame standoff distance due to soot/sootshell formation effects, the quantitative agreement was improved --the modeling predictions of the soot standoff ratio were within 10 percent of measured values. Normal-gravity (earth-gravity) methanol

combustion experiments have revealed a substantial degree of water absorption during the combustion of methanol, which can modify both the burning rate and the extinction process. Small levels (100's ppm) of formaldehyde were also detected. These experiments substantiate that certain single-component fuels can display multi-component burning characteristics. However, similar experiments for n-alkane fuels indicate that the degree of product and intermediate absorption is negligible. The substitution of O2/HNe environments for O2/N2 environments produced substantially higher burning rates and larger extinction diameters for methanol droplets. Utilizing a 50 percent O2/He environment at 1 atmosphere, the first well-characterized extinction measurements were obtained. This dissertation also demonstrates a rapid and accurate computer-based, image processing method for the analysis of the photographic records from the microgravity and normal-gravity experiments. An alternative technique of producing reduced-gravity conditions to study freely-falling droplets of less than 500 micron diameter is proposed. The unique feature of this experiment is that cold gas flow will be used to simplify the geometry of the tube needed to accelerate the co-flowing gas to match the acceleration of the freely-falling droplets. Dissert. Abstr.

N93-23428*# National Aeronautics and Space Administration, Washington, DC.

MICROGRAVITY SCIENCE AND APPLICATIONS: PROGRAM TASKS AND BIBLIOGRAPHY FOR FY 1992

Mar. 1993 366 p

(NASA-TM-4469; NAS 1.15:4469) Avail: CASI HC A16/MF A03

This report is a compilation of the FY 1992 Principal Investigator program task descriptions funded by the Microgravity Science and Applications Division (MSAD), NASA Headquarters, Washington, DC. The document also provides a bibliography of FY 1992 publications and presentations cited by MSAD Principal Investigators, and an index of the Principal Investigators and their affiliations. The purpose of the document is to provide an overview and progress report for the funded tasks for scientists and researchers in industry, university, and government communities. The tasks are grouped into three categories appropriate to the type of research being done-space flight, ground based, and advanced technology development-and by science discipline. The science disciplines are: biotechnology, combustion science,, electronic materials, fluid physics, fundamental physics, glass and ceramics, metals and alloys, and protein crystal growth. Author

N93-24600* National Aeronautics and Space Administration. Pasadena Office, CA.

SAMPLE POSITIONING IN MICROGRAVITY Patent

Govind Sridharan, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 27 Apr. 1993 7 p Filed 1 Nov. 1991 supersedes N92-30083 (30 - 20, p 3428)

(Contract NAS7-918)

(NASA-Case-NPO-18448-1-CU; US-Patent-5,206,504;

US-Patent-Appl-SN-786612; US-Patent-Class-250-251;

Int-Patent-Class-H05H-3/04) Avail: US Patent and Trademark Office

Repulsion forces arising from laser beams are provided to produce mild positioning forces on a sample in microgravity vacuum environments. The system of the preferred embodiment positions samples using a plurality of pulsed lasers providing opposing repulsion forces. The lasers are positioned around the periphery of a confinement area and expanded to create a confinement zone. The grouped laser configuration, in coordination with position sensing devices, creates a feedback servo whereby stable position control of a sample within microgravity environment can be achieved.

Official Gazette of the U.S. Patent and Trademark Office

N93-22626*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

GAS-GRAIN SIMULATION FACILITY (GGSF)

Ken Greenwald *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 261-274 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

N93-22642*# National Aeronautics and Space Administration, Washington, DC.

RESEARCH OBJECTIVES, OPPORTUNITIES, AND FACILITIES FOR MICROGRAVITY SCIENCE

Robert J. Bayuzick *In its* Space Station Freedom Utilization Conference 1992 p 427-462 Prepared in cooperation with Vanderbilt Univ., Nashville, TN (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

N93-22643*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

SPACE STATION FREEDOM COMBUSTION RESEARCH

G. M. Faeth *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 463-474 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

N93-22644*# National Aeronautics and Space Administration, Washington, DC.

MICROGRAVITY FLUID PHYSICS RESEARCH IN THE SPACE STATION FREEDOM ERA

Bradley M. Carpenter *In its* Space Station Freedom Utilization Conference 1992 p 475-479 (For primary document see N93-22606 08-18)

Avail: CASI HC A01/MF A04

N93-22645*# Wisconsin Univ., Madison. Dept. of Materials Science and Engineering.

MATERIALS SCIENCE RESEARCH IN MICROGRAVITY

John H. Perepezko *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 481-500 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

N93-22646*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PROTEIN CRYSTAL GROWTH IN MICROGRAVITY

Daniel Carter *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 501-509 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

N93-22648*# Alabama Univ., Birmingham. Center for Macromolecular Crystallography.

LARGE SCALE CRYSTALLIZATION OF PROTEIN PHARMACEUTICALS IN MICROGRAVITY VIA TEMPERATURE CHANGE

Marianna M. Long *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 531-552 (For primary document see N93-22606 08-18)

(Grant NAGw-813)

Avail: CASI HC A03/MF A04

N93-22652*# Boeing Defense and Space Group, Seattle, WA.

INTEGRATION AND USE OF MICROGRAVITY RESEARCH FACILITY: LESSONS LEARNED BY THE CRYSTALS BY VAPOR TRANSPORT EXPERIMENT AND SPACE EXPERIMENTS FACILITY PROGRAMS

Barbara L. Heizer *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 589-600 (For primary document see N93-22606 08-18)

Avail: CASI HC A03/MF A04

N93-24340# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Microgravity User Support Center.

USER SUPPORT FOR THE SPACELAB MISSION D-2

D. Padeken, M. Schuber, F. Gillessen, R. Naehle, and G. Schmitz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 19-24 (For primary document see N93-24336 08-12)

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N93-24359# Austrian Research Center, Seibersdorf.

LOGION: OPERATION OF A LIQUID METAL ION EMITTER MODULE UNDER MICROGRAVITY

F. G. Ruedenauer, W. Riedler (Academy of Sciences, Graz, Austria.), V.

Berzhatyi (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), M. Fehringer, E. Goeschl (Academy of Sciences, Graz, Austria.), C. Kropiunig (Academy of Sciences, Graz, Austria.), L. Neznamova (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), W. Steiger, and K. Torkar (Academy of Sciences, Graz, Austria.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 121-125 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24364# Innsbruck Univ. (Austria). Dept. of Neurology.
COGIMIR: A STUDY OF COGNITIVE FUNCTIONS IN MICROGRAVITY
T. Benke, O. Koserenko (Institute of Biomedical Problems, Moscow, USSR.), F. Gerstenbrand, and N. Watson (British Columbia Univ., Vancouver.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation or Earth Orbiting Laboratories Jul. 1992 p 153-155 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24368# Technische Univ., Graz (Austria). Physiologisches Inst.
THE EFFECT OF MICROGRAVITY ON TREMOR (MICROVIBRATION)
E. Gallasch, I. B. Kozlovskaya (Institute of Biomedical Problems, Moscow, USSR.), M. Moser, M. Borisov (Institute of Biomedical Problems, Moscow, USSR.), J. Hindinger, A. Konev (Institute of Biomedical Problems, Moscow, USSR.), and T. Kenner *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 175-180 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)
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N93-24369# Technische Univ., Graz (Austria). Working Group for Volume Regulation and Space Medicine.
ALTERED FLUID SHIFT DYNAMICS WITH 6 DAYS IN MICROGRAVITY
H. G. Hinghofer-Szalkay, E. M. Koenig, G. Sauseng-Fellegger, C. Zambo-Polz, J. Schmied (Labor fuer Messtechnik dr. Hans Stabinger, Graz, Austria.), H. Heimel (Labor fuer Messtechnik dr. Hans Stabinger, Graz, Austria.), V. B. Noskov (Institute of Biomedical Problems, Moscow, USSR.), I. Pestov (Institute of Biomedical Problems, Moscow, USSR.), and A. I. Grigoriev (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 181-186 Sponsored by Bundesministerium fuer Wissenschaft und Forschung and Oesterreichische Akademie der Wissenschaften (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24372# Bristol Univ. (England). Physics Lab.
GRAVITY-RELATED PHENOMENA IN MATERIALS SCIENCE
D. T. J. Hurle *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 201-206 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24396# Officine Galileo S.p.A., Florence (Italy).
THE SURFACE PLASMON SPECTROSCOPY APPLICATIONS IN MICROGRAVITY: THE MEASUREMENT THEORY AND PRELIMINARY EXPERIMENTAL LAYOUT
G. Margheri, M. Tacconi, and P. G. Falciani *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 335-338 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N93-22018# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.
ADVANCES IN GUIDANCE AND CONTROL OF PRECISION GUIDED WEAPONS [LES AVANCEES DANS LE DOMAINE DU GUIDAGE ET DU PILOTAGE DES ARMES GUIDEES DE PRECISION]
Nov. 1992 122 p 54th Symposium held in Ottawa, Canada, 12-14 May 1992
(AGARD-CP-524; ISBN-92-835-0692-8) Copyright Avail: CASI HC A06/MF A02

This volume contains the Technical Evaluation Report and the 12 unclassified papers, presented at the Guidance and Control Panel Symposium held in Ottawa, Canada from 12th-14th may 1992. The papers were presented covering the following headings: (1) Desert Storm Experience; (2) Advanced Sensors; (3) Guidance and Control Techniques; (4) System Concepts and Assessments; and (5) Standoff Weapons and Technology. For individual titles, see N93-22019 through N93-22030.

N93-22019# Naval Air Warfare Center, China Lake, CA. Weapons Div.
ELECTROMAGNETIC RADIATING SOURCE ELIMINATION (ERASE) PROGRAM **c32**
Don R. Stapleton, George W. Hoppus, and Robert E. Sutton *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 4 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A01/MF A02

The ERASE program has been for many years a principle source of advanced research and development work within the U.S. Department of Defense in support of the lethal defense suppression warfare mission area. Projects conducted at the U.S. Naval Weapons Center, China Lake, California (now part of the U.S. Naval Air Warfare Center), under the ERASE program, have been remarkably successful in both discovering and proving new technologies needed in lethal defense suppression, and in working with industry to transition this technology to fleet weapons prepared to support U.S. and NATO forces. Author

N93-22020# British Aerospace Systems and Equipment Ltd., Plymouth (England).
ADVANCES IN AUTOMATIC ELECTRO-OPTICAL TRACKING SYSTEMS **c74**
Anthony J. E. Moy and Andrew D. Hughes *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 12 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A03/MF A02

British Aerospace (Systems & Equipment) Ltd (BASE) has been working in the field of automatic electro-optical tracking (Autotrack) systems for more than 12 years. BASE Autotrack systems carry out the automatic detection, tracking and classification of missiles and targets using image processing techniques operating on data received from electro-optical sensors. Typical systems also produce control data to move the sensor platform, enabling moving targets to be tracked accurately over a wide range of conditions. BASE Autotrack systems have been well proven in land, sea and air applications. This paper discusses the relevance of Autotrack systems to modern high-technology warfare and charts the progress of their development within BASE, both with respect to current products and active research programs. Two third generation BASE Autotrack systems are described, one of which provided a sophisticated air-to-ground tracking capability in the recent Gulf War. The latest Autotrack product is also described; this uses ASIC and Transputer technology to provide a high-performance, compact, missile and target tracker. Reference is also made to BASE's research work. Topics include an ASIC correlator, point target detection and, in particular, the use of neural networks for real-time target classification. Author

N93-22021# GEC Avionics Ltd., Rochester (England). Guidance Systems Div.

INITIAL TRIALS RESULTS FOR IMAGE STABILISATION USING A RUGGED LOW NOISE GYROSCOPE **c35**

D. G. Harris *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 7 p (For primary document see N93-22018 08-31)

Copyright Avail: CASI HC A02/MF A02

Several motion sensors of novel design have been developed during the past decade with the guided weapon or projectile market as the target user. In addition to technical performance requirements, all such sensors must be very robust with small size and mass, low power consumption and low cost. START is an angular rate sensor developed for this purpose. However, the guided munitions market has been very slow to evolve and new applications were sought in which the characteristics listed above, plus a very long operating and shelf life could be exploited. The field of image stabilization seemed promising and applications for use were followed up. The paper describes the characteristics of START which make it suited to this field and discusses some of the specific applications and the results achieved in tests of these equipments. Author

N93-22022# Computing Devices Co., Ottawa (Ontario). Ground Systems Div.

MULTI-WINDOW REGISTRATION ALGORITHM FOR AUTOMATIC DETECTION AND TRACKING OF MOVING TARGETS **c61**

P. Church and T. Gajdicar *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 7 p (For primary document see N93-22018 08-31)

Copyright Avail: CASI HC A02/MF A02

Image registration is an important preprocessing step often used in applications, such as automatic target tracking, to decouple image motion from target motion. This paper presents an image registration algorithm designed for a real-time implementation on platforms such as precision guided weapons. The algorithm uses a set of small optimal windows to register successive images from a video sequence. The windows are tracked over time and assessed for their quality in providing a good and persistent registration measure. Areas selected over moving objects are also detected and replaced. The image motion vectors obtained from each window are used to estimate the image motion correction. Evaluation of the performance of the algorithm in critical areas, such as its expected registration accuracy and its tolerance to image deformation caused by rotation, are presented. Results are presented when the algorithm is applied, in conjunction with a motion tracker, to the detection and tracking of targets in video sequences acquired from moving platforms and presenting difficulties of partial occlusion, high background clutter and low target-to-background contrast. The registration algorithm has demonstrated properties of robustness and computational efficiency that are of interest for guided weapons applications. The limitations of the method are also discussed. Author

N93-22023# Naval Air Warfare Center, China Lake, CA. Weapons Div.

THE MISSLE-BORNE INTEGRATED NETWORK DEMONSTRATION PROGRAM **c63**

M. L. Mumford, D. K. Andes, and L. L. Kern *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 8 p (For primary document see N93-22018 08-31)

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The Missile-Borne Integrated Neural Network Demonstration (MINND) Program is a Navy 6.3A Advanced Technology Demonstration program, with the goal of demonstrating the application of artificial neural network technology to improving the performance of IR seekers. The specific technical objective is to demonstrate the realtime detection of moving point targets in IR clutter. The program has developed neural network-based system design in several stages of increasing capability for moving target detection. The program has developed several stages of hardware, supporting neural chip testing/learning, followed by realtime processing hardware for implementation of software designs. MINND is currently in its final phase of integrated demonstration testing using real sensor inputs. Author

N93-22024# Bilkent Univ., Ankara (Turkey).

MULTIVARIABLE FREQUENCY RESPONSE METHODS FOR OPTIMAL KALMAN-BUCY FILTERS WITH APPLICATIONS TO RADAR TRACKING SYSTEMS **c32**

C. C. Arcasoy *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 14 p (For primary document see N93-22018 08-31)

Copyright Avail: CASI HC A03/MF A02

The problem of multi-output, infinite-time, linear time-invariant optimal Kalman-Bucy filter both in continuous and discrete-time cases in frequency domain is addressed. A simple new algorithm is given for the analytical solution to the steady-state gain of the optimum filter based on a transfer function approach. The algorithm is based on spectral factorization of observed spectral density matrix of the filter which generates directly the return-difference matrix of the optimal filter. The method is more direct than by algebraic Riccati equation solution and can easily be implemented on digital computer. The design procedure is illustrated by examples and closed-form solution of ECV and ECA radar tracking filters are considered as an application of the method. Author

N93-22025# Prins Maurits Lab. TNO, Rijswijk (Netherlands).

SYSTEM EVALUATION OF A FIBER OPTIC GUIDED MISSILE WITH A SIMPLE GUIDANCE ADDITION TO IMPROVE SYSTEM EFFECTIVENESS **c74**

A. J. Krabbendam *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 12 p (For primary document see N93-22018 08-31)

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Based on lessons learned during the accomplishment of a National Technology Project in the Netherlands, a simple and low cost Fiber Optic Guided Weapon (FOGW) concept was contrived. The main characteristics of the concept are the short range of 10 km, the simple strapdown television CCD-camera, and the solid fuel rocket propulsion. This low cost concept is more closely examined. The concept was evaluated by conducting flight trajectory simulations. An already existing six degrees of freedom (6-DOF) trajectory simulation program was modified. The program and especially the relatively simple target sensor system model are described. The problem of choosing an appropriate target configuration for system evaluation is attended to. A target configuration consists of various target positions, various target maneuvers, and various target speeds. The probability of hit is calculated for a chosen target configuration base-case. Miscellaneous model parameters are varied, especially the target sensor system is investigated. The probability of hit is determined as a function of the sensor resolution, the sensor field of view, and the modeled characteristics of the image processing algorithm. Another investigation concerns a simple addition to the normal guidance commands trying to reduce target-lost situations. The effect of two different implementations of this addition is calculated for the same situation as the basic guidance configuration. Author (revised)

N93-22026# Naval Air Warfare Center, China Lake, CA. Weapons Div.

LINEAR PAYOUT SYSTEMS FOR DISPENSING FIBER-OPTIC DATA LINKS FROM PRECISION-GUIDED MUNITIONS OR HIGH-PERFORMANCE AIRCRAFT/MISSLES **c74**

F. Hoban and D. Harms *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 5 p (For primary document see N93-22018 08-31)

Copyright Avail: CASI HC A01/MF A02

Theoretical studies and empirical tests were conducted as part of the development and demonstration of a fiber-optic data link for weapon system guidance and control. These studies characterized the performance capability of several unique payout system concepts that permit the dispensing of a small diameter (170- to 250-micrometer) fiber-optic data link from military weapon systems at high subsonic velocities. Theoretical predictions were compared with laboratory payout test results. Several engineering models that allow linear dispensing of the fiber from a fiber canister or spool were developed and tested. Material, mechanical, and physical concepts evaluated included spiral flow of air through a payout nozzle, rotating nozzles with fixed geometries, fiber adhesives, and mechanical vibrations. Fiber real-time payout tension loads were measured for several fiber diameters and adhesives. Excellent results were obtained with a silicon-based adhesive

with a low coefficient of friction and a 170-micrometer-diameter fiber. The prototype tests verified the results predicted by the theoretical string dynamical models. Author

N93-22027# Naval Air Warfare Center, China Lake, CA. Attack Weapons Dept.

VERSATILE ATTACK WEAPON

D. Quist *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 4 p (For primary document see N93-22018 08-31)

Copyright Avail: CASI HC A01/MF A02

The air defense threat to air strike forces continues to increase, both in quality and quantity. Third World countries now possess Integrated Air Defense (AID) capabilities equaling that of major powers. Radio Frequency (RF) only Anti-Radiation Homing (ARH) weapons are being effectively neutralized by countermeasure improvements in these land based and satellite IAD systems. The cost of piecemeal modification of existing weapon systems or the continuous fielding of threat specific weapon systems is becoming prohibitive. A low funded in-house project was started in 1988 that confronts this defense threat situation with a multi-mode multi-mission weapon system which is affordable to employ in large quantities. The system has capabilities as both a defense suppression weapon and a surgical strike weapon. Employment can be facilitated from a reduced threat environment to air strike forces. Other objectives for this innovative weapon system are the capabilities for high target damage, countermeasure resistance, real time aim point selection, and real time Battle Damage Assessment (BDA). Technical feasibility of the various system and subsystem elements were verified by theoretical analysis. Many were also verified by physical demonstration in prototype hardware. Author (revised)

N93-22028# Dornier System G.m.b.H., Friedrichshafen (Germany).

THE AVIONIC SYSTEM OF THE EXPERIMENTAL STANDOFF DISPENSER ADW **c06**

Juergen Scheuch *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 6 p (For primary document see N93-22018 08-31)

Copyright Avail: CASI HC A02/MF A02

Last year, Dornier, a company of Deutsche Aerospace (DASA, Deutsche Aerospace AG) successfully completed flight tests with an experimental standoff dispenser, called ADW. ADW is the abbreviation of the German words for 'Standoff Dispenser Weapon' (ADW, Abstands Dispenser Waffe). The ADW test vehicle is an autonomous guided, non-powered missile with high navigation accuracy. It is used for in-flight ejection tests with different types of submunitions. It is equipped with an INS (Inertial Navigation System) updated by GPS (Global Positioning System) in order to guarantee a precise target approach. Author (revised)

N93-22029# Alenia Aeronautica, Torino (Italy). Defense Aircraft Div.

SYSTEM CONCEPT FOR AN ADVANCED STAND-OFF WEAPON

Riccardo Barzan *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 8 p (For primary document see N93-22018 08-31)

Copyright Avail: CASI HC A02/MF A02

A typical conceptual design process is described as applicable to an advanced Stand Off Weapon (SOW). Different design requirement sets, which include system performance parameters, are established to satisfy different mission requirements. In order to cope with these sets and to reach the flexibility needed, some specific design criteria are suggested. The trade between modularity and commonality makes the difference among different SOW's and affects them in affordability and effectiveness. The Skyshark weapon system is given as example of an SOW system concept. The description allows the understanding of links between design requirements, design criteria, and technical characteristics. Extensive modularity is adopted for all components that enhance flexibility (Armament, Avionics, Propulsion), while a favorable configuration layout choice allows maximizing commonality. This paper presents an industrial point of view and is related to almost 10 years of Alenia activities on Stand Off Weapons. Author (revised)

N93-22030# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).

RADAR SEEKER BASED AUTONOMOUS NAVIGATION UPDATE SYSTEM USING TOPOGRAPHY FEATURE MATCHING TECHNIQUES **c32**

H. D. Lerche and F. Tumbreagel *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 13 p (For primary document see N93-22018 08-31)

Copyright Avail: CASI HC A03/MF A02

The discussed navigation update system was designed for an unmanned platform with fire and forget capability. It meets the requirement due to fully autonomous operation. The system concept will be characterized by complementary use of the radar seeker for target identification as well as for navigation function. The system works in the navigation mode during preprogrammable phases where the primary target identification function is not active or in parallel processing. The dual function radar seeker system navigates the drone during the midcourse and terminal phases of the mission. Its high resolution due to range measurement and doppler beam sharpening in context with its radar reflectivity sensing capability are the basis for topography referenced navigation computation. The detected height jumps (coming from terrain elevation and cultural objects) and radar reflectivity features will be matched together with topography referenced features. The database comprises elevation data and selected radar reflectivity features that are robust against seasonal influences. The operational benefits of the discussed system are as follows: (1) the improved navigation performance with high probability of position fixing, even over flat terrain; (2) the operation within higher altitudes; and (3) bad weather capability. The developed software modules were verified with captive flight test data running in a hardware-in-the-loop simulation. Author (revised)

N93-22035* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

METHOD AND APPARATUS FOR CLEANING RUBBER DEPOSITS FROM AIRPORT RUNWAYS AND ROADWAYS Patent

Sandy M. Stubbs, inventor (to NASA) 6 Apr. 1993 5 p Filed 3 Apr. 1991 Supersedes N91-28455 (29 - 20, p 3332)

(NASA-Case-LAR-14483-1; US-Patent-5,199,128; US-Patent-Appl-SN-682153; US-Patent-Class-15-52; US-Patent-Class-15-80; US-Patent-Class-15-87; Int-Patent-Class-A47L-11/282) Avail: US Patent and Trademark Office

A method and apparatus for cleaning rubber deposits from surfaces such as airport runways and roadways is disclosed. The apparatus includes a large vehicle that has the capacity to be loaded so as to effectively add weight to the rubber cleaning tires of the vehicle. In addition, the vehicle has a water tank and sprinkler system so that the surface may be wetted down in front of the tires as the vehicle proceeds across the surface. The cleaning tires of the apparatus are aligned so that they are at a yaw angle to the direction of travel, and the cleaning tire assembly is attached to the underside of the trailer of the vehicle and positioned between a forward and rear water tank. In addition, this tire assembly is equipped with a means of loading the tires onto the contaminated surface. The method comprises driving such a vehicle at low speeds down the surface as the road is being wet in front of the cleaning tires. The effect of the angled tires is to create a scrubbing action that not only heats the rubber deposits by friction but also causes it to be removed from the surface. The rubber that does not stick to the cleaning tires is then removed from the surface by sweeping. Official Gazette of the U.S. Patent and Trademark Office

N93-22079# National Inst. of Standards and Technology, Gaithersburg, MD. Precision Engineering Div.

A COMPARISON OF NATIONAL STANDARDS FOR THE PERFORMANCE EVALUATION OF COORDINATE MEASURING MACHINES IN TERMS OF LENGTH-BASED DIMENSIONAL QUANTITIES

Dennis A. Swyt Nov. 1992 15 p

(PB93-139004; NISTIR-4978) Avail: CASI HC A03/MF A01

U.S., German, British, and Japanese standards for evaluation of coordinate measuring machines are compared and it is shown that using a variety of special artifacts the U.S. standard alone specifies separate tests for each of the four modes of length measurements (displacement, position, distance, and extension) and that, depending on the number and orientations of faces probed, a bi-directional step gage of the type suggested in the

other standards can be used for tests of each of these four modes.
Author (revised)

N93-22416# Fermi National Accelerator Lab., Batavia, IL.
PS1 SATELLITE REFRIGERATOR HEAT EXCHANGER: FAILURE OF THE LN2 HEAT EXCHANGER TO LOW PRESSURE HELIUM
B. Squires Nov. 1992 17 p
(Contract DE-AC02-76CH-03000)
(DE93-005616; FNAL-TM-1811) Avail: CASI HC A03/MF A01

The PS1 heat exchanger is one of three prototype heat exchangers built in support of a contract for Satellite Refrigerator Heat Exchanger components. This heat exchanger was first put into operation in Jul. 1983. In Nov. 1991, this heat exchanger experienced a failure in the shell of heat exchanger 1 causing nitrogen to contaminate the helium in the refrigerator. The resulting contamination plugged heat exchanger 3. The break occurred at a weld that connects a 0.25 inch thick ring to heat exchanger 1. The failure appears to be a fatigue of the shell due to temperature oscillations. The flow rate through the break was measured to be 1.0 scfm for a pressure drop over the crack of 50 psi. An ANSYS analysis of the failure area indicates that the stress would be 83,000 psi if the metal did not yield. This is based on cooling down the shell to 80K from 300K with the shell side helium on the outside of the shell at 300K. This is the largest change in temperature that occurs during operation. During normal operations, the temperature swings are not nearly this large, however temperatures down to 80K are not unusual (LN2 overflowing pot). The highest temperatures are typically 260K. The analysis makes no attempt to estimate the stress concentration factor at this weld, but there is no doubt that it is greater than 1. No estimate as to the number of cycles to cause failure was calculated nor any estimate as to the actual number of cycles was made. DOE

N93-22600# Sandia National Labs., Albuquerque, NM.
A DISTRIBUTED VISUALIZATION ENVIRONMENT FOR ENGINEERING SCIENCES
C. J. Pavlakos, L. A. Schoof, and J. F. Mareda Dec. 1992 9 p
(Contract DE-AC04-76DP-00789)
(DE93-006961; SAND-92-0778) Avail: CASI HC A02/MF A01

In this paper, we characterize a visualization environment that has been designed and prototyped for a large community of scientists and engineers. The proposed environment makes use of a visualization server concept to provide effective, interactive visualization to the user's desktop. Benefits of using the visualization server approach are discussed. Some thoughts regarding desirable features for visualization server hardware architectures are also addressed. A brief discussion of the software environment is included. The paper concludes by summarizing certain observations which we have made regarding the implementation of such visualization environments. DOE

N93-22768# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
THE COLLABORATIVE PROGRAM OF RESEARCH IN ENGINEERING SCIENCES Annual Report, 1 Sep. 1991 - 31 Aug. 1992
D. E. Hardt Sep. 1992 44 p Prepared in cooperation with Idaho National Engineering Lab., Idaho Falls, ID
(Contract DE-FG02-85ER-13331)
(DE93-005126; DOE/ER-13331/T4) Avail: CASI HC A03/MF A01

In 1985, the Energy Laboratory of the Massachusetts Institute of Technology (MIT) and the Idaho National Engineering Laboratory (INEL) began a collaborative program of energy-related engineering research. This program was extended for another three years begining in Jan. 1991. The program continues to pursue three broad goals: to perform quality research on energy-related technologies involved in industrial processes and productivity; to demonstrate the potential of collaborative programs between universities and the national laboratories; and to encourage the transfer of the technology developed to the industrial sector. This annual report describes progress at MIT under the MIT/INEL program during the past year. DOE

N93-22770# Technical Research Centre of Finland, Espoo. Fire Technology Lab.
ANALYSIS OF UPWARD FLAME SPREAD
Djebar Baroudi and Matti Kokkala 1992 50 p
(DE93-752850; VTT-PUB-89) Avail: CASI HC A03/MF A01

Upward flame spread on wall linings is analyzed theoretically with special emphasis on the application of the models to predict whether the flame spread will be deceleratory or acceleratory. Much of the work is devoted to a revised application of the model by Saito et al. By applying various analytical expressions for the rate of heat release, quantitative expressions for the flame spread velocity are derived. Criteria for accelerating flame spread are presented. Due to the lack of large-scale flame spread tests, the predictions are compared with material data and room fire test results in Swedish BRANDFORSK test series on wall lining materials and in the EUREFIC program. DOE

N93-22895# National Inst. of Standards and Technology, Gaithersburg, MD.
SPECIFICATIONS, TOLERANCES, AND OTHER TECHNICAL REQUIREMENTS FOR WEIGHING AND MEASURING DEVICES AS ADOPTED BY THE 77TH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES, 1992 Handbook
Henry V. Oppermann, ed. Oct. 1992 217 p
(PB93-130474; NIST/HB-44) Avail: CASI HC A10/MF A03

Handbook 44 was first published in 1949, having been preceded by similar handbooks of various designations and in several forms beginning in 1918. The 1993 edition was developed by the Committee on specifications and Tolerances of the National Conference on Weights and Measures with the assistance of the Office of Weights and Measures of the National Institute of Standards and Technology. It includes amendments adopted in the 77th annual meeting of the National Conference on Weights and Measures in 1992. Handbook 44 is published in its entirety each year following the annual meeting of the National Conference on Weights and Measures. GRA

N93-22970# Technical Research Centre of Finland, Espoo. Safety Engineering Lab.
SNEAK ANALYSIS APPLIED TO PROCESS SYSTEMS
Cris Whetton (Sheffield Univ., England.) 1992 96 p
(DE93-752866; VTT-TIED-1376) Avail: CASI HC A05/MF A01

Traditional safety analyses, such as HAZOP, FMEA, FTA, and MORT, are less than effective at identifying hazards resulting from incorrect 'flow' - whether this be flow of information, actions, electric current, or even the literal flow of process fluids. Sneak Analysis (SA) has existed since the mid nineteen-seventies as a means of identifying such conditions in electric circuits; in which area, it is usually known as Sneak Circuit Analysis (SCA). This paper extends the ideas of Sneak Circuit Analysis to a general method of Sneak Analysis applied to process plant. The methods of SA attempt to capitalize on previous work in the electrical field by first producing a pseudo-electrical analog of the process and then analyzing the analog by the existing techniques of SCA, supplemented by some additional rules and clues specific to processes. The SA method is not intended to replace any existing method of safety analysis; instead, it is intended to supplement such techniques as HAZOP and FMEA by providing systematic procedures for the identification of a class of potential problems which are not well covered by any other method. DOE

N93-23136*# National Aeronautics and Space Administration, Washington, DC.
FY 1991 SAFETY PROGRAM STATUS REPORT
1991 38 p
(NASA-TM-108707; NAS 1.15:108707) Avail: CASI HC A03/MF A01

In FY 1991, the NASA Safety Division continued efforts to enhance the quality and productivity of its safety oversight function. Recent initiatives set forth in areas such as training, risk management, safety assurance, operational safety, and safety information systems have matured into viable programs contributing to the safety and success of activities throughout the Agency. Efforts continued to develop a centralized intra-agency safety training program with establishment of the NASA Safety Training Center at the Johnson Space Center (JSC). The objective is to provide quality training for NASA employees and contractors on a broad range of safety-related topics. Courses developed by the Training Center will be presented at various NASA locations to minimize travel and reach the greatest number of people at the least cost. In FY 1991, as part of the ongoing efforts to enhance the total quality of NASA's safety work force, the Safety Training Center initiated development of a Certified Safety Professional review course. This course provides a comprehensive review of the skills and knowledge

that well-rounded safety professionals must possess to qualify for professional certification. FY 1992 will see the course presented to NASA and contractor employees at all installations via the NASA Video Teleconference System. Derived from text

N93-23170 California Univ., Davis.
AN EVALUATION OF MAGNETIC REFRIGERATION CYCLES BASED ON HOW EFFECTIVELY THE THERMAL PROPERTIES OF THE REFRIGERANT ARE UTILIZED Ph.D. Thesis
Duane Paul Siemens 1992 105 p
Avail: Univ. Microfilms Order No. DA9232861

In an effort to show that the magnetothermal properties of a material can be varied in a manner useful for magnetic refrigeration, Gd doped EuS has been synthesized using an arc melting technique and its magnetic heat capacity measured. The heat capacity data shows little change from pure EuS, probably due to compensation of the donor clectrons caused by inhomogeneous doping. Analysis of the data in terms of its refrigerant capacity and comparison to mean field calculations indicate that EuS is a more effective refrigerant in the 4-35 K region than Gd3Ga5O12 and that for applied fields below 1 Tesla the effects of domains and irreversibilities may be relatively more significant than at higher fields. Also a figure of merit has been developed to evaluate the effort required, due to the intrinsic properties of the materials, to implement a given refrigeration cycle. On the basis of this figure of merit a simple scaling argument indicates that a refrigeration cycle using active magnetic regeneration would be better than a single stage, passively regenerated cycle when the temperature span is greater than the heat source temperature. In addition, an analysis of an idealized Ericsson cycle using active magnetic regeneration is made and a technique to match the fixed temperature ends to the regenerator temperature variation is developed that shows qualitative new features not previously recognized. Dissert. Abstr.

N93-23176*# Martin Marietta Corp., New Orleans, LA. Manned Space Systems.
CYCLE O (CY 1991) NLS TRADE STUDIES AND ANALYSES, BOOK 2. PART 1: AVIONICS AND SYSTEMS Final Report, May 1991 - Jan. 1992
Richard Harris and Zach Kirkland Jan. 1992 254 p
(Contract NAS8-37143)
(NASA-CR-184472; NAS 1.26:184472; MMC-NLS-SR.001-Bk-2-Pt-1) Avail: CASI HC A12/MF A03

An assessment was conducted to determine the maximum LH2 tank stretch capability based on the constraints of the manufacturing, tooling and facilities at the Michoud Assembly Facility in New Orleans, Louisiana. The maximum tank stretch was determined to be 5 ft. with minor or no modifications, a stretch of 11 ft. with some possible facility modifications and beyond 11 ft. significant new facilities are required. A cost analysis was performed to evaluate the impacts for various stretch lengths. Tasks that were defined to perform trades and studies regarding the best approach to meet requirements for the National Launch System Avionics are also discussed. Derived from text

N93-23209*# National Aeronautics and Space Administration, Washington, DC.
NASA METRIC TRANSITION PLAN
1992 39 p
(NASA-TM-108606; NAS 1.15:108606) Avail: CASI HC A03/MF A01

NASA science publications have used the metric system of measurement since 1970. Although NASA has maintained a metric use policy since 1979, practical constraints have restricted actual use of metric units. In 1988, an amendment to the Metric Conversion Act of 1975 required the Federal Government to adopt the metric system except where impractical. In response to Public Law 100-418 and Executive Order 12770, NASA revised its metric use policy and developed this Metric Transition Plan. NASA's goal is to use the metric system for program development and functional support activities to the greatest practical extent by the end of 1995. The introduction of the metric system into new flight programs will determine the pace of the metric transition. Transition of institutional capabilities and support functions will be phased to enable use of the metric system in flight program development and operations. Externally oriented elements of this plan will introduce and actively support use of the metric system in education, public information, and small business programs. The plan also establishes a procedure for evaluating and approving waivers and exceptions to the required use of the metric system for new programs. Coordination with other Federal agencies and departments (through the Interagency Council on Metric Policy) and industry (directly and through professional societies and interest groups) will identify sources of external support and minimize duplication of effort. Author

N93-23270# National Inst. of Standards and Technology, Gaithersburg, MD.
THE 77TH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES Final Report
Carroll S. Brickenkamp and Ann H. Turner Oct. 1992 372 p Conference held at Nashville, TN, 19-23 Jul. 1992
(PB93-130466; NIST/SP-845; LC-26-27766) Avail: CASI HC A16/MF A03

The 77th Annual Meeting of the National Conference on Weights and Measures (NCWM) was held July 19 through 23, 1992, at the Stouffer Nashville Hotel in Nashville, Tennessee. The theme of the meeting was 'Partnerships for Progress'. Reports by the standing and annual committees of the conference comprise the major portion of the publication, along with the addresses delivered by conference officials and other authorities from government and industry. Special meetings included those of the metrologists, the Associate Membership Committee, the Retired Officials Committee, the Scale Manufacturers' Association, the American Petroleum Institute, the Industry Committee on Packaging and Labeling, the regional weights and measure associations, and the National Association of State Departments of Agriculture Weights and Measures Division, and the National Council on State Metrication. GRA

N93-23280# National Inst. of Standards and Technology, Gaithersburg, MD.
COMPARISON OF FULL SCALE FIRE TESTS AND A COMPUTER FIRE MODEL OF SEVERAL SMOKE EJECTION EXPERIMENTS
Emil Braun, Darren L. Lowe, Walter W. Jones, Patricia Tatem, Richard Carey, and Jean Bailey Nov. 1992 44 p Sponsored by Naval Research Lab. Prepared in cooperations with David Taylor Research Center, Annapolis, MD
(PB93-139087; NISTIR-4961) Avail: CASI HC A03/MF A01

Data were obtained from four large scale shipboard fire tests. The test series was designed to evaluate the efficacy of a smoke ejection system for the removal of smoke and heat from compartments around the compartment of fire origin. Using diesel oil and polyethylene beads as fuel, tests were conducted at 0.5 MW. GRA

N93-23284# National Inst. of Standards and Technology, Gaithersburg, MD. Precision Engineering Div.
FEDERAL MOVE TO METRIC: PUBLIC LAW, DOC AND NIST
Dennis A. Swyt Dec. 1992 14 p
(PB93-139129; NISTIR-4761) Avail: CASI HC A03/MF A01

Since its initial development, the metric system of measurement has evolved to become the modern International System of Units (SI) and has been formally accepted by all the nations of the world save three and all the industralized nations save one, the United States. Recently, Congress passed the Metric Usage Act of 1988, requiring all Federal agencies, including the National Institute of Standards and Technology, to plan and implement conversion to use of metric in their business-related activities and assigned responsibility for coordination of Federal agency conversion to the Department of Commerce. This paper reviews briefly the Federal legislative history of metric use in the U.S., metric practice associated with the modernized system, and the policies and plans of the Federal government in its legislatively-mandated conversion to use of that system. GRA

N93-23430*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.
EVALUATION OF KAPTON PYROLYSIS, ARC TRACKING, AND FLASHOVER ON SiO(x)-COATED POLYIMIDE INSULATED SAMPLES OF FLAT FLEXIBLE CURRENT CARRIERS FOR SPACE STATION FREEDOM
Thomas J. Stueber and Chris Mundson (Cleveland State Univ., OH.) Apr. 1993 11 p
(Contract NAS3-25266; RTOP 474-46-10)
(NASA-CR-191106; E-7706; NAS 1.26:191106) Avail: CASI HC A03/MF A01

Kapton polyimide wiring insulation was found to be vulnerable to pyrolization, arc tracking, and flashover when momentary short-circuit arcs have occurred on aircraft power systems. Short-circuit arcs between wire pairs can pyrolize the polyimide resulting in a conductive char between conductors that may sustain the arc (arc tracking). Furthermore, the arc tracking may spread (flashover) to other wire pairs within a wire bundle. Polyimide Kapton will also be used as the insulating material for the flexible current carrier (FCC) of Space Station Freedom (SSF). The FCC, with conductors in a planar type geometric layout as opposed to bundles, is known to sustain arc tracking at proposed SSF power levels. Tests were conducted in a vacuum bell jar that was designed to conduct polyimide pyrolysis, arc tracking, and flashover studies on samples of SSF's FCC. Test results will be reported concerning the minimal power level needed to sustain arc tracking and the FCC susceptibility to flashover. Results of the FCC arc tracking tests indicate that only 22 volt amps were necessary to sustain arc tracking (proposed SSF power level is 400 watts). FCC flashover studies indicate that the flashover event is highly unlikely.

Author (revised)

N93-23435# National Inst. of Standards and Technology, Gaithersburg, MD. Building and Fire Research Lab.

SMOKE MOVEMENT IN A CORRIDOR-HYBRID MODEL, SIMPLE MODEL, AND COMPARISON WITH EXPERIMENTS

Takayuki Matsushita and John H. Klote Dec. 1992 53 p

(PB93-146678; NISTIR-4982) Avail: CASI HC A04/MF A01

A hybrid model for simulating smoke movement in a corridor is described. This model uses a two zone approach which considers velocities in each zone, and uses a fine mesh in the direction of propagation. Two different approaches to deal with the pressure term are addressed. Full scale and reduced scale experiments are described and compared with the results of the hybrid model. Since heat transfer is not presently incorporated in the hybrid model, the simulated velocity of spread is constant. But in the experiment, the velocity drops with advancing time. A simple model with heat transfer is also described. This model is similar to the density flow model, and assumes that the movement of the smoke front (nose) is similar to the flow through vertical openings in a zone model. Results of the simple model are compared with the experiment with heat transfer, and the effect of the heat transfer coefficient is observed. GRA

N93-23715*# Martin Marietta Corp., New Orleans, LA. Manned Space Systems.

CYCLE O(CY1991) NLS TRADE STUDIES AND ANALYSES REPORT. BOOK 2, PART 2: PROPULSION Report, May 1991 - Jan. 1992

R. Cronin, M. Werner, S. Bonson, R. Spring, and R. Houston Jan. 1992 281 p

(Contract NAS8-37143)

(NASA-CR-184472; NAS 1.26:184472; MMC-NLS-SR.001-Bk-2-Pt-2) Avail: CASI HC A13/MF A03

This report documents the propulsion system tasks performed in support of the National Launch System (NLS) Cycle O preliminary design activities. The report includes trades and analyses covering the following subjects: (1) Maximum Tank Stretch Study; (2) No LOX Bleed Performance Analysis; (3) LOX Bleed Trade Study; (4) LO2 Tank Pressure Limits; (5) LOX Tank Pressurization System Using Helium; (6) Space Transportation Main Engine (STME) Heat Exchanger Performance; (7) LH2 Passive Recirculation Performance Analysis; (8) LH2 Bleed/Recirculation Study; (9) LH2 Tank Pressure Limits; and (10) LH2 Pressurization System. For each trade study an executive summary and a detailed trade study are provided. For the convenience of the reader, a separate section containing a compilation of only the executive summaries is also provided. Author

N93-24495# Science Applications, Inc., San Diego, CA. Foreign Applied Sciences Assessment Center.

PENETRATION MECHANICS RESEARCH IN THE FORMER SOVIET UNION

W. M. Isbell, C. E. Anderson, J. R. Asay, S. J. Bless, and D. E. Grady Sep. 1992 251 p

(PB93-146488) Avail: CASI HC A12/MF A03

Recently published papers by scientists from the former Soviet Union reveal to Western researchers a mature body of highly inventive and dedicated research. To analyze and assess this work, a group of six internationally recognized U.S. experts in the field of penetration mechanics and hypervelocity impact reviewed hundreds of unclassified documents. Five broad, sometimes overlapping, research areas were chosen for assessment: hypervelocity impact capabilities; penetration mechanics experiments at ordnance velocities; analytical penetration mechanics; material response to high-velocity impact and penetration; and numerical simulations of penetration physics. Both similarities and differences between Soviet and Western research were noted and characterized, with particular attention paid to potential breakthrough technologies. Leading Soviet scientists and their organizations were identified, as were areas of potentially fruitful collaboration between researchers from the former Soviet Union and the United States. Soviet breakthroughs in penetration mechanics technology that far out-distanced Western efforts were not found, though potential breakthroughs were noted in several areas, including penetration models of brittle materials (principally ceramics), superdeep penetration of particles, and very-high-velocity electromagnetic launchers. Author

N93-24559# Computer Sciences Corp., Cincinnati, OH.

USER'S GUIDE TO FLEXIBLE MEMBRANE LINER ADVISORY EXPERT SYSTEM, FLEX VERSION 3.0

T. Adams and J. McCready Dec. 1992 32 p Sponsored by EPA

(Contract EPA-68-WO-0043)

(PB93-134872; EPA/600/C-92/006; EPA/SW/DK-93/029A) Avail: CASI HC A03/MF A01

The guide is a user manual for the Flexible Membrane Liner Advisory Expert System (FLEX). The system assists in determining if a proposed synthetic liner material will be chemically resistant to a proposed or anticipated leachate from a hazardous waste land disposal site. More specifically, it analyzes EPA required physical property test data (Method 9090) and provides textual advice about data adequacy and specific indicators that a liner may not be chemically resistant. Author

N93-24635# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

ADVANCED INSULATIONS FOR REFRIGERATOR/FREEZERS: THE POTENTIAL FOR NEW SHELL DESIGN INCORPORATING POLYMER BARRIER CONSTRUCTION Final Report, Aug. 1991 - Nov. 1992

B. Griffith and D. Arasteh Jan. 1993 36 p Sponsored by EPA

(PB93-146991; EPA/600/R-93/009) Avail: CASI HC A03/MF A01

The report examines domestic refrigerator/freezer (R/F) design alternatives which may offer greater increase in thermal performance than is possible with panel/foam composites. (NOTE: Current efforts to design and build R/Fs with high performance insulation technology are directed at using vacuum panels in a composite with polymer foam to improve performance; however, certain restrictions generally enable only relatively small improvement in thermal resistance using these techniques.) These design alternatives involve basic redesign of the R/F and use of alternative materials of construction. One design alternative includes use of a polymer outer shell material component that incorporates in its construction an advanced insulation technology that reduces thermal bridging and edge losses. Computer modelling of a R/F door incorporating the concept shows a doubling of effective thermal resistance over conventional R/F designs. The report also addresses materials and manufacturing technologies needed to fabricate polymer barrier advanced insulation components for R/Fs.

GRA

N93-22166*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

COP IMPROVEMENT OF REFRIGERATOR/FREEZERS, AIR-CONDITIONERS, AND HEAT PUMPS USING NONAZEOTROPIC REFRIGERANT MIXTURES

Douglas G. Westra *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 164-173 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

N93-22174*# Allied-Signal Corp., Kansas City, MO.

INTEGRATED FLEXIBLE MANUFACTURING PROGRAM FOR MANUFACTURING AUTOMATION AND RAPID PROTOTYPING

S. L. Brooks, C. W. Brown, M. S. King, W. R. Simons, and J. J. Zimmerman *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993

p 245-253 (For primary document see N93-22149 08-99)
(Contract DE-AC04-76DP-00613)
Avail: CASI HC A02/MF A04

N93-22175*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTOMATED FIBER PLACEMENT COMPOSITE MANUFACTURING: THE MISSION AT MSFC'S PRODUCTIVITY ENHANCEMENT COMPLEX
John H. Vickers and Larry I. Pelham (Thiokol Corp., Huntsville, AL.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 255-261 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22196*# National Aeronautics and Space Administration, Washington, DC.
A NEW TECHNOLOGY FOR MANUFACTURING SCHEDULING DERIVED FROM SPACE SYSTEM OPERATIONS
R. S. Hornstein and J. K. Willoughby (Avyx, Inc., Englewood, CO.) *In its* Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 447-453 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22834# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).
LIQUID DROPLET RADIATOR: DESIGN CONCEPTS AND DEVELOPMENT LOGIC
Alois Koeppl and Bernhard J. G. Leidinger *In* ESA, Fluids in Space Jun. 1992 p 61-78 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H., Bremen, Germany (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N93-22399# Naval Postgraduate School, Monterey, CA. Dept. of Electrical and Computer Engineering.
WIDEBANDING TECHNIQUES FOR VHF ANTENNAS, 1 Technical Report, 1 Oct. 1991 - 30 Sep. 1992
Ramakrishna Janaswamy 30 Sep. 1992 38 p
(AD-A259301; NPS-EC-92-010) Avail: CASI HC A03/MF A01

A straight wire antenna of fixed length is narrow band due to the rapid variations in its input impedance, and to a lesser degree, in its radiation pattern. A wire antenna is, however, lightweight, easy to fabricate and simple to mount on any platform. To make a wire antenna broadband, we need resistive and/or reactive loading along its length. In this report, we consider monopole antennas loaded with modified Wu-King resistivity profile, and complex lumped loads. A 1-m monopole antenna is considered over 30-90 MHz. Input impedance and radiation efficiency data for the two cases are generated by employing the moment method. Tuning networks are designed using the real frequency method of Carlin to maximize the power transfer from a 50 ohm source to the antenna. Overall performance of the antenna by taking into account the mismatch loss due to the tuning network and resistive loss due to the loading is studied. GRA

N93-22407# California Univ., Los Angeles. School of Engineering and Applied Science.
EXPERIMENTAL, THEORETICAL AND COMPUTATIONAL STUDY OF FREQUENCY UPSHIFT OF ELECTROMAGNETIC RADIATION USING PLASMA TECHNIQUES
C. Joshi Sep. 1992 32 p
(Contract DE-FG03-91ER-12114)
(DE93-005092; DOE/ER-12114/2) Avail: CASI HC A03/MF A01

This following is a second year progress report on 'Experimental, Theoretical, and Computational Study of Frequency Upshift of Electromagnetic Radiation Using Plasma Techniques.' The highlights are presented. Ionization fronts were shown to frequency upshift EM radiation by greater than a factor 5. In the experiments, 33 GHz microwave radiation is upshifted to more than 175 GHz using a relativistically propagating ionization front created by a laser beam. A Letter describing the results was published in Physical Review Letters and an invited paper was submitted to IEEE Trans. in Plasma Science. DOE

N93-22421# Wisconsin Univ., Madison. Dept. of Nuclear Engineering and Engineering Physics.
LOW FREQUENCY RF CURRENT DRIVE
N. Hershkowitz 1992 32 p
(Contract DE-FG02-88ER-53264)
(DE93-005130; DOE/ER-53264/3) Avail: CASI HC A03/MF A01

An unshielded antenna for RF heating was developed and tested during the report period. In addition to design specifications being given, some experimental results are presented utilizing: (1) an unprotected Faraday shield; (2) insulating guard limiters; (3) unshielded antenna experiments; (4) method for detecting small RF driven currents; (5) RF fast wave current drive experiments; (6) alfven wave interactions with electrons; and (7) machine conditioning, impurity generation, and density control. DOE

N93-22433# Los Alamos National Lab., NM.
ON USING SCATTERING STATISTICS FOR ULTRA WIDEBAND ELECTROMAGNETIC TARGET CLASSIFICATION AND IDENTIFICATION
E. K. Miller 1992 15 p Presented at the 4th International Conference on Ultra-Wideband, Short-Pulse Electromagnetics, Brooklyn, NY, 8-10 Oct. 1992
(Contract W-7405-eng-36)
(DE93-003809; LA-UR-92-3581; CONF-9210166-3) Avail: CASI HC A03/MF A01

An interrogating electromagnetic field has information encoded upon it by any target from which it scatters. This process presents the electomagneticest/signal processor with a problem that ranges across questions such as (1) detection--is there a target?; (2) to which class does that target belong?; (3) what specific member of that class is the target?; and (4) what are the targets electrical and/or geometrical properties in increasing order of specificity and information requirements? Radar systems have been analyzed primarily from the perspective of question (1) above. In recent years, however, increasing attention has been devoted to questions (2)-(4) as the need for more specific and complete information beyond target detection has arisen. In the following discussion, we present conceptually a statistics, information-oriented approach to this general class of problems. DOE

N93-22455*# Applied Research, Inc., Huntsville, AL.
EMERGENCY VEHICLE ALERT SYSTEM, PHASE 2
Tom Barr, Warren Harper, Bill Reed, and David Wallace 29 Jan. 1993 152 p
(Contract NAS8-39383)
(NASA-CR-192464; NAS 1.26:192464; ARI/92-R-050) Avail: CASI HC A08/MF A02

The EVAS provides warning for hearing-impaired motor vehicle drivers that an emergency vehicle is in the local vicinity. Direction and distance to the emergency vehicle are presented visually to the driver. This is accomplished by a special RF transmission/reception system. During this phase the receiver and transmitter from Phase 1 were updated and modified and a directional antenna developed. The system was then field tested with good results. Static and dynamic (moving vehicle) tests were made with the direction determined correctly 98 percent of the time. Author

N93-22467*# Michigan Univ., Ann Arbor. Radiation Lab.
A CLASS OF HYBRID FINITE ELEMENT METHODS FOR ELECTROMAGNETICS: A REVIEW
J. L. Volakis, A. Chatterjee, and J. Gong Mar. 1993 36 p
(Contract NCA2-653)

(NASA-CR-192631; NAS 1.26:192631; UMICH-028918-4-T) Avail: CASI HC A03/MF A01

Integral equation methods have generally been the workhorse for antenna and scattering computations. In the case of antennas, they continue to be the prominent computational approach, but for scattering applications the requirement for large-scale computations has turned researchers' attention to near neighbor methods such as the finite element method, which has low O(N) storage requirements and is readily adaptable in modeling complex geometrical features and material inhomogeneities. In this paper, we review three hybrid finite element methods for simulating composite scatterers, conformal microstrip antennas, and finite periodic arrays. Specifically, we discuss the finite element method and its application to electromagnetic problems when combined with the boundary integral, absorbing boundary conditions, and artificial absorbers for terminating the mesh. Particular attention is given to large-scale simulations, methods, and solvers for achieving low memory requirements and code performance on parallel computing architectures. Author (revised)

N93-22470*# RMS Associates, Linthicum Heights, MD.
NEWLY AVAILABLE TECHNOLOGIES PRESENT EXPANDING OPPORTUNITIES FOR SCIENTIFIC AND TECHNICAL INFORMATION EXCHANGE

Jean M. Tolzman Mar. 1993 17 p
(Contract NASw-4584)
(NASA-CR-4494; NAS 1.26:4494) Avail: CASI HC A03/MF A01

The potential for expanded communication among researchers, scholars, and students is supported by growth in the capabilities for electronic communication as well as expanding access to various forms of electronic interchange and computing capabilities. Research supported by the National Aeronautics and Space Administration points to a future where workstations with audio and video monitors and screen-sharing protocols are used to support collaborations with colleagues located throughout the world. Instruments and sensors all over the world will produce data streams that will be brought together and analyzed to produce new findings, which in turn can be distributed electronically. New forms of electronic journals will emerge and provide opportunities for researchers and scientists to electronically and interactively exchange information in a wide range of structures and formats. Ultimately, the wide-scale use of these technologies in the dissemination of research results and the stimulation of collegial dialogue will change the way we represent and express our knowledge of the world. A new paradigm will evolve-perhaps a truly worldwide 'invisible college'. Author (revised)

N93-22477*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COMMUNICATIONS AND CONTROL FOR ELECTRIC POWER SYSTEMS Report, 1991

H. Kirkham 15 Jan. 1992 87 p Prepared for Department of Energy, Washington, DC
(Contract NAS7-918)
(NASA-CR-192794; JPL-Publ-92-19; NAS 1.26:192794) Avail: CASI HC A05/MF A01

A long-term strategy for the integration of new control technologies for power generation and delivery is proposed: the industry would benefit from an evolutionary approach that would adapt to its needs future technologies as well as those that it has so far not heeded. The integrated operation of the entire system, including the distribution system, was proposed as a future goal. The AbNET communication protocols are reviewed, and additions that were made in 1991 are described. In the original network, traffic was controlled by polling at the master station, located at the substation, and routed by a flooding algorithm. In a revised version, the polling and flooding are modified. The question of interfacing low-energy measurement transducers or instrument transformers is considered. There is presently little or no agreement on what the output of optical current transducers (CT's) should be. Appendices deal with the calibration of current transducers; with Delta modulation, a simple means of serially encoding the output of an OCT; and with noise shaping, a method of digital signal processing that trades off the number of bits in a digital sample for a higher number of samples. Author (revised)

N93-22478*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE GOLDSTONE SOLAR SYSTEM RADAR: A SCIENCE INSTRUMENT FOR PLANETARY RESEARCH

J. D. Dvorsky, N. A. Renzetti, and D. E. Fulton 15 Dec. 1992 128 p
(Contract NAS7-918)
(NASA-CR-192793; JPL-Publ-92-29; NAS 1.26:192793) Avail: CASI HC A07/MF A02

The Goldstone Solar System Radar (GSSR) station at NASA's Deep Space Communications Complex in California's Mojave Desert is described. A short chronological account of the GSSR's technical development and scientific discoveries is given. This is followed by a basic discussion of how information is derived from the radar echo and how the raw information can be used to increase understanding of the solar system. A moderately detailed description of the radar system is given, and the engineering performance of the radar is discussed. The operating characteristics of the Arcibo Observatory in Puerto Rico are briefly described and compared with those of the GSSR. Planned and in-process improvements to the existing radar, as well as the performance of a hypothetical 128-m diameter antenna radar station, are described. A comprehensive bibliography of referred scientific and engineering articles presenting results that depended on data gathered by the instrument is provided. Author

N93-22483*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
REAL-TIME TRANSMISSION OF DIGITAL VIDEO USING VARIABLE-LENGTH CODING

Thomas P. Bizon, Mary Jo Shalkhauser, and Wayne A. Whyte, Jr. Mar. 1993 17 p Presented at the Data Compression Conference (DCC '93), Snowbird, UT, 30 Mar. - 1 Apr. 1993; sponsored by the IEEE
(RTOP 144-10-10)
(NASA-TM-106092; E-7730; NAS 1.15:106092) Avail: CASI HC A03/MF A01

Huffman coding is a variable-length lossless compression technique where data with a high probability of occurrence is represented with short codewords, while 'not-so-likely' data is assigned longer codewords. Compression is achieved when the high-probability levels occur so frequently that their benefit outweighs any penalty paid when a less likely input occurs. One instance where Huffman coding is extremely effective occurs when data is highly predictable and differential coding can be applied (as with a digital video signal). For that reason, it is desirable to apply this compression technique to digital video transmission; however, special care must be taken in order to implement a communication protocol utilizing Huffman coding. This paper addresses several of the issues relating to the real-time transmission of Huffman-coded digital video over a constant-rate serial channel. Topics discussed include data rate conversion (from variable to a fixed rate), efficient data buffering, channel coding, recovery from communication errors, decoder synchronization, and decoder architectures. A description of the hardware developed to execute Huffman coding and serial transmission is also included. Although this paper focuses on matters relating to Huffman-coded digital video, the techniques discussed can easily be generalized for a variety of applications which require transmission of variable-length data. Author (revised)

N93-22582# Stanford Univ., CA. Linear Accelerator Center.
ELECTROMAGNETISM FROM COUNTING

H. P. Noyes Dec. 1992 11 p Presented at the 3rd Physical Interpretations of Relativity Theory Conference, London, England, 14-18 Sep. 1992
(Contract DE-AC03-76SF-00515)
(DE93-006930; SU-SLAC-PUB-5858; CONF-9209298-1) Avail: CASI HC A03/MF A01

The fact that experimental accuracy is finite makes the measurement of particle positions and velocities non-local and often non-commutative even in a scale invariant theory. Applied to electromagnetic and gravitational phenomena, we argue that this leads to a relativistic action at a distance theory in which 'fields' are simply a quasi-local interpolating concept extrapolated from macroscopic conservation laws. We sketch how this analysis could lead to classical field equations as a macroscopic approximation to relativistic quantum mechanics, but do not construct a formal proof. DOE

N93-22656# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abt. HF-Physik.
POLARIMETRIC INVESTIGATION OF EDGE SCATTERING BY MONO- AND BISTATIC MICROWAVE IMAGING Ph.D. Thesis - Ulm Univ. [POLARIMETRISCHE UNTERSUCHUNG DER KANTENSTREUUNG IN DER MONO- UND BISTATISCHEN MIKROWELLENABBILDUNG]
Wolfgang Herdeg Jul. 1991 153 p In GERMAN
(DLR-FB-91-32; ETN-93-91922) Avail: CASI HC A08/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The scattering of electromagnetic waves from edges is investigated with regard to frequency, aspect angle, polarization, and bistatic angle. The edges of simple metal objects (cubes, plates, and wedges) are resolved in range and cross range using a high resolution microwave imaging process and are investigated as canonical structures. The Geometrical Theory of Diffraction (GTD) is used as a theoretical model. The scattering coefficients of GTD are compared with experiment. The polarimetric results are presented using the Hymen parameters. Microwave mirrors, which are large metal plates which reflect the bistatic scattering contribution to the monostatic radar, are introduced, in order to carry out bistatic measurements on a monostatic radar range. Experimental results are in agreement with the proposed concepts. ESA

N93-22682# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.
DETECTABILITY OF HIGH POWER AIRCRAFT [ENTDECKBARKEIT VON HOCHLEISTUNGS-FLUGZEUGEN]
Klaus Uwe Dettmar, Juergen Kruse, and Gerhard Loebert May 1992 8 p In GERMAN Submitted for publication
(MBB-FE-S-PUB-0490; ETN-93-93424) Avail: CASI HC A02/MF A01

In addition to the measures aiming at improving the probability of survival for an aircraft, including aircraft performance, flight profile selection, efficient electronic warfare equipment, and self protection weapons, it is shown that an efficient measure consists of reducing aircraft signature (radar, infrared, acoustic, visual) in connection with the use of signature avionics. The American 'stealth' aircrafts are described as examples. ESA

N93-22814# Defence Research Establishment, Ottawa (Ontario).
DATA SELECTION FOR FAST PROJECTION TECHNIQUES: A COMPARATIVE STUDY OF DIRECTION FINDING PERFORMANCE Technical Report
Mylene Toulgoat and Ross M. Turner Dec. 1992 31 p
(AD-A259916; DREO-1135) Avail: CASI HC A03/MF A01

This report describes simulation studies of fast projection techniques for direction finding of jammer signals. These techniques are based on a data selection criterion applied directly to the data vectors obtained at the output of an antenna array. The selected data vectors are used in fast projection algorithms to estimate the jammer subspace and then calculate the directional spectrum. Three such algorithms are described ranging from the fastest but least effective to the most computationally demanding but most effective. These algorithms provide a better tradeoff of performance versus computational load than has been available. Relative performance is compared with that of the MUSIC technique for test cases which evaluate the minimum resolution threshold achievable and the effect of the jammer strength relative to the receiver noise. GRA

N93-22931# Florida Inst. of Tech., Melbourne.
SMART ELECTROMAGNETIC STRUCTURES: THE NEURAL ANTENNA Final Report, 15 Aug. 1989 - 14 Aug. 1992
Michael H. Thursby 11 Jan. 1993 18 p
(Contract DAAL03-89-G-0085)
(AD-A260469; ARO-27191.5-EL-SM) Avail: CASI HC A03/MF A01

Smart electromagnetic structures (SEMS) are defined as structures capable of interacting with their surrounding electromagnetic fields and either influencing the field or sensing and adapting to its presence. A structure is smart when it integrates sensing elements (e.g., antennas), processing elements (neural networks) and control elements (diodes) autonomously. SEMS provide an adaptive electromagnetic (EM) environment for the structure on which they are mounted. The ability to adapt derives from the closed loop nature of the SEMS. The speed of adaptation is determined by the speed of the loop, which is set by the computational elements. Our experiments shown the time required for a response is about fifteen gate delays. The integration of artificial neural processors with tuneable antennas was proposed several years ago by our group. This synergy over the past three years was studied. The control of the operating frequency of a microstrip patch antenna was demonstrated. We believe that ours is a unique program offering great potential for payoff in the area of electromagnetic smart skins. Our main goal in this program was to '...determine the feasibility of a neural network controlled antenna and to quantify the ability of the antenna and the NN to learn to tune automatically to the center frequency of a received signal.' These goals were achieved and spun off neural networks that have application of radar and communications systems. Because of its self adaptability the closed loop neural control of an antenna element, provides the potential for design of an easily manufacturable antenna which is immune to typical siting problems, and is tolerant to moderate external damage. GRA

N93-22946# California Univ., Los Angeles. Dept. of Electrical Engineering.
GUIDED WAVE PHENOMENA IN MILLIMETER WAVE INTEGRATED CIRCUITS AND COMPONENTS Final Report, 1 Mar. 1988 - 31 Dec. 1992
Tatsuo Itoh 31 Jan. 1993 34 p Prepared in cooperation with Univ. of Texas, Austin, TX
(Contract DAAL03-88-K-0005)
(AD-A260407; ARO-25045.68-EL) Avail: CASI HC A03/MF A01

Representative projects from Army Research Office are summarized. Following the narrative descriptions with appropriate illustrations, a complete list of articles published in scientific journals and those presented at national and international conferences is provided. Lists of personnel and advanced degrees are also included. The projects were carried out at The University of Texas at Austin and later at UCLA. Topics covered include: quasi-optical technique; active antenna; active filter; traveling wave transistor; slow wave, planar transmission line; and discontinuities. GRA

N93-22980# Oak Ridge National Lab., TN.
GEOMAGNETIC STORM ENVIRONMENTS AND EFFECTS ON ELECTRICAL SYSTEMS
F. M. Tesche and P. R. Barnes 1992 6 p Presented at the 10th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, 9-11 Mar. 1993
(Contract DE-AC05-84OR-21400)
(DE92-041257; CONF-930353-1) Avail: CASI HC A02/MF A01

This paper briefly reviews the behavior of the earth's magnetic field during a geomagnetic storm. Temporal variations of the B-field on the earths surface can induce an electric field in the earth, and this E-field will induce currents to flow in long, grounded conductors. Previous experience with geomagnetic storms indicates that such geomagnetically-induced currents can cause damage to power system components, and at times, can cause power blackouts. This paper presents some recently measured geomagnetic field variations, and illustrates how the induced electric field can be calculated, assuming a simple model of the imperfectly conducting earth. This calculation may be performed either in the time or in the frequency domain. Approximations to the time dependence of the geomagnetic field permit an analytical evaluation of the corresponding E-field in the earth, and this results in a simple expression for the transient Enfield. A knowledge of this Enfield is important in understanding the effects of geomagnetic storms on the power system, and in devising protection methods. DOE

N93-23046# Federal Aviation Administration, Atlantic City, NJ.
CONTROLLER EVALUATION OF INITIAL TERMINAL DATA LINK ATC SERVICES: MINI STUDY 3 Final Report
Dec. 1992 138 p
(Contract FAA-T2001-B)
(DOT/FAA/CT-92/18) Avail: CASI HC A07/MF A02

This report documents the third Federal Aviation Administration (FAA) controller evaluation of an initial group of four terminal air traffic control (ATC) services and functions which are under development for implementation on a Data Link airground communications system. The research was conducted at the Federal Aviation Administration Technical Center by the Research Directorate for Aviation Technology, Airborne Collision Avoidance and Data Systems Branch, ACD-320. Author

N93-23062*# Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering.

FOCAL PLANE ARRAYS FOR SUBMILLIMETER WAVES USING TWO-DIMENSIONAL ELECTRON GAS ELEMENTS: A GRANT UNDER THE INNOVATIVE RESEARCH PROGRAM Final Report, 1 Mar. 1989 - 29 Feb. 1992

K. Sigfrid Yngvesson and Kei-May Lau 29 Feb. 1992 57 p

(Grant NAGw-1659)

(NASA-CR-192271; NAS 1.26:192271) Avail: CASI HC A04/MF A01

This final report describes a three-year research effort, aimed at developing new types of THz low noise receivers, based on bulk effect ('hot electron') nonlinearities in the Two-Dimensional Electron Gas (2DEG) Medium, and the inclusion of such receivers in focal plane arrays. 2DEG hot electron mixers have been demonstrated at 35 and 94 GHz with three orders of magnitude wider bandwidth than previous hot electron mixers, which use bulk InSb. The 2DEG mixers employ a new mode of operation, which was invented during this program. Only moderate cooling is required for this mode, to temperatures in the range 20-77 K. Based on the results of this research, it is now possible to design a hot electron mixer focal plane array for the THz range, which is anticipated to have a DSB receiver noise temperature of 500-1000K. In our work on this grant, we have found similar results the the Cronin group (resident at the University of Bath, UK). Neither group has so far demonstrated heterodyne detection in this mode, however. We discovered and explored some new effects in the magnetic field mode, and these are described in the report. In particular, detection of 94 GHz and 238 GHz, respectively, by a new effect, 'Shubnikov de Haas detection', was found to be considerably stronger in our materials than the cyclotron resonance detection. All experiments utilized devices with an active 2DEG region of size of the order of 10-40 micrometers long, and 20-200 micrometers wide, formed at the heterojunction between AlGaAs and GaAs. All device fabrication was performed in-house. The materials for the devices were also grown in-house, utilizing OMCVD (Organo Metallic Chemical Vapor Deposition). In the course of this grant, we developed new techniques for growing AlGaAs/GaAs with mobilities equalling the highest values published by any laboratory. We believe that the field of hot electron mixers and detectors will grow substantially in importance in the next few years, partly as a result of the opportunity given us through this grant, which represents the major effort in the US so far. We note, however, that parallel research on hot electron mixers in thin film superconductors in Russia, and recently in Sweden, have demonstrated mixing up to 1 THz, with the potential for low-noise receivers for frequencies up to many THz. The three groups recently assessed the relative adtantages of 2DEG and superconducting film mixers in a joint paper (Kollberg et al., 1992; see Appendix II). Author (revised)

N93-23195*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

RLE PROGRESS REPORT NO. 133, 1 JANUARY - 31 DECEMBER 1990

Jonathan Allen, Daniel Kleppner, Mary J. Ziegler, ed., and Barbara Passero, ed. 31 Dec. 1990 15 p

(Grant NAGw-1272)

(NASA-CR-192144; NAS 1.26:192144) Copyright Avail: CASI HC A03/MF A01

Activities of the Research Laboratory of Electronics at MIT are summarized. NASA-sponsored research in the area of synthetic aperture radar image interpretation and simulation is described. Other government-sponsored and industry-sponsored studies are also described which address the following topics: microwave and millimeter wave integrated circuits, high-speed integrated circuit interconnects, Instrument Landing System/Microwave Landing System frequency management assessment, and superconducting electronics. CASI

N93-23215*# Clarkson Univ., Potsdam, NY. Dept. of Electrical and Computer Engineering.

COMBINED MAGNETIC VECTOR-SCALAR POTENTIAL FINITE ELEMENT COMPUTATION OF 3D MAGNETIC FIELD AND PERFORMANCE OF MODIFIED LUNDELL ALTERNATORS IN SPACE STATION APPLICATIONS Ph.D. Thesis

Ren H. Wang 27 Feb. 1991 337 p

(Grant NAG3-818)

(NASA-CR-192348; NAS 1.26:192348) Avail: CASI HC A15/MF A03

A method of combined use of magnetic vector potential (MVP) based finite element (FE) formulations and magnetic scalar potential (MSP) based FE formulations for computation of three-dimensional (3D) magnetostatic fields is developed. This combined MVP-MSP 3D-FE method leads to considerable reduction by nearly a factor of 3 in the number of unknowns in comparison to the number of unknowns which must be computed in global MVP based FE solutions. This method allows one to incorporate portions of iron cores sandwiched in between coils (conductors) in current-carrying regions. Thus, it greatly simplifies the geometries of current carrying regions (in comparison with the exclusive MSP based methods) in electric machinery applications. A unique feature of this approach is that the global MSP solution is single valued in nature, that is, no branch cut is needed. This is again a superiority over the exclusive MSP based methods. A Newton-Raphson procedure with a concept of an adaptive relaxation factor was developed and successfully used in solving the 3D-FE problem with magnetic material anisotropy and nonlinearity. Accordingly, this combined MVP-MSP 3D-FE method is most suited for solution of large scale global type magnetic field computations in rotating electric machinery with very complex magnetic circuit geometries, as well as nonlinear and anisotropic material properties. Author

N93-23268# Federal Communications Commission, Washington, DC. Computer Applications Div.

COMMON CARRIER EARTH STATION APPLICATION

29 Dec. 1992 138 p

(PB93-111722; FCC/DF/MT-89/005A) Avail: CASI HC A07/MF A02

The report provides documentation for the Common Carrier Earth Station Application File used by the Common Carrier bureau in processing applications for licenses and permits. Each application is made up of 15 records containing such information as the status of the station, identification information, and any special provisions. Author

N93-23271# RAND Corp., Santa Monica, CA.

EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE. APRELIMINARY ANALYSIS

S. M. Besen 1991 15 p Sponsored by NSF

(Grant NSF IRI-88-05845)

(PB93-138824; RAND/N-3320-NSF) Avail: CASI HC A03/MF A01

The European Telecommunications Standards Institute (ETSI) was formed to accelerate standardization and promote greater harmonization among European telecommunications systems. The article describes ETSI's organization and structure and relates them to its expected behavior and performance. Some characteristics such as the use of weighted majority voting rule, are likely to expedite the setting of standards; others, such as the institute's diverse membership and the decision to avoid recognizing alternative standards, may make it more difficult. Overall, ETSI's structure may be seen as an effort to find the right balance of features. GRA

N93-23313# Oak Ridge National Lab., TN.

LASER RANGE CAMERA DATA FUSION

M. Beckerman and F. J. Sweeney 1993 7 p Presented at the 5th Topical Meeting on Robotics and Remote Systems, Knoxville, TN, 26-29 Apr. 1993

(Contract DE-AC05-84OR-21400)

(DE93-005159; CONF-930403-9) Avail: CASI HC A02/MF A01

Results are presented of an investigation of the fusion of image data from amplitude-modulated CW laser radar. The goal is the design of an algorithm for simultaneously recovering the underlying surfaces and discontinuities in a manner which is free from errors and artifacts. To accomplish this goal, the images are modeled as a set of coupled Markov random fields. These fields, defined within a Bayesian framework, describe the smooth-surface, discontinuity, and noise properties of the images. As a resuli of the Markovian property simulated annealing can be used to find the global miminum. DOE

N93-23331# European Space Agency, Paris (France).

FOCUSED TWO-DIMENSIONAL RADAR IMAGING USING COHERENT TIME DOMAIN SIGNALS

Karl-Heinz Bethke (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) Aug. 1992 84 p Transl. into ENGLISH of Fokussierte Zweidimensionale Radarabbildung Durch Koharente Signalverarbeitung im Zeitbereich Original language document was announced as N92-19360

(ESA-TT-1272; DLR-FB-91-19; ETN-93-93518) Avail: CASI HC A05/MF A01; original German version available from DLR, Wissenschatfliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A rapid method for generating two dimensional focused radar images of rotating objects is presented. While range resolution is performed in discrete range steps in real time using a coherent short pulse radar, the cross range resolution is generated using the synthetic aperture principle, by means of efficient fast Fourier transform algorithms with subsequent data processing. The degradation in the imaging performance resulting from the imaging algorithm as well as from migration of scattering centers through a plurality of resolution cells is eliminated by an extended phase correction and by a tracking procedure acting on the moving scattering centers. This is done by reorganizing the range-sweep data in range: at every range steps are used to form a focused image. Experimental results demonstrate the capability of the presented imaging procedure. ESA

N93-23342# MPB Technologies, Inc., Pointe Claire (Quebec).
ELECTROMAGNETIC SCATTERING CROSS SECTIONS FROM THE BODIES OF REVOLUTION, VOLUME 1 Final Report
P. Park and J.-M. Beaulieu Sep. 1991 438 p
(Contract DSS-W-7714-8-5829)
(DREV-CR-645; MPBT-335-2; CTN-93-60674) Avail: CASI HC A19/MF A04

The electromagnetic scattering from perfectly conducting, dielectric, and coated bodies of revolution is computed using the moment method technique. The electric field integral equation is used to formulate the problem and the corresponding equations are solved numerically. A numerical code is developed, tested, and verified. A series of measurements was carried out at an electromagnetic measurement facility for coated and uncoated perfectly conducting cylinders. The measured values are compared with the computed results. Satisfactory agreements are achieved for cylinder sizes up to 6 wavelengths. The accuracy, convergence, and range of applicability of the numerical code are investigated by computing the extinction coefficients as a function of the number of expansion functions at various size parameters and dielectric constants. The number of expansions required to achieve a given accuracy increases linearly with the size parameter. No strong dependence is observed with respect to dielectric constant as long as it is greater than 0.01. A brief study of cavity resonance effects was carried out, and a possible method to identify and remove these spurious phenomena is suggested. Author (CISTI)

N93-23344# Department of National Defence, Ottawa (Ontario). Research and Development Branch.
HIGH ARCTIC HIGH FREQUENCY RADIO COMMUNICATIONS AND A SEVEN DAY POLAR CAP ABSORPTION EVENT
Mervin R. Black Nov. 1991 32 p
(DREP-TM-91-18; CTN-93-60713) Avail: CASI HC A03/MF A01

High frequency radio communications experienced in the high Arctic during the Iceshelf 91 Arctic Acoustics field program are reported. During the 19 Mar. - 26 Apr. 1991 period, high frequency radio communications which rely on ionospheric reflection for propagation were monitored, and the ability to communicate using single sideband voice mode was recorded. In the period studied, radio conditions ranged from very good to a complete blackout for seven days (23-30 March) during a severe polar cap absorption event. Propagation prediction bulletins prepared by the USAF Global Weather Center in Nebraska were used on a daily basis for operational planning where good radio communication conditions with remote field camps and transiting aircraft were critical. Good agreement was found between the predictions and the observed communication conditions. The eleven-year sunspot cycle peaked in 1990 but is still expected to have a significant effect on radio communication conditions for one or two more field seasons. Author (CISTI)

N93-23367# Helsinki Univ. of Technology, Espoo (Finland). Communications Lab.
MICROWAVE LINE-OF-SIGHT CHANNEL MEASUREMENTS, CHANNEL MODELLING, AND APPLICATION OF CHANNEL MODELS TO DIGITAL RADIO PERFORMANCE PREDICTION Ph.D. Thesis
Sven-Gustav Haeggman Helsinki, Finland Finnish Academy of Technology 1991 55 p Sponsored in part by Telecom Finland, and Tekniikan Edistaemissaeaetioe
(Acta-Pol-Scand-El-69; ISBN-951-666-336-2; ETN-93-93477) Avail: CASI HC A04/MF A01

Time and frequency domain measurements with pulse and sweep techniques, derivation of channel models from the results, and application of the model to performance prediction are studied. The measuring systems and the methods leading to channel models are reviewed. Statistical models are obtained only from the frequency domain results. Single and two channel models for signal level equivalent three path models are derived. The latter single and two channel models are also available as parameter time history. Three performance prediction approaches are tried. The first approach is based on Rummler's channel model and on signature sets for various interference conditions. The second approach is based on the derived channel models. Several methods are used, also a new method where time is divided into mutually exclusive flat and dispersive fade time. The total outage can be summed, but normally flat fading outage can be neglected. The third approach is based on the time history model. Outage state is determined from signature sets, and cumulative outage is obtained from the stored time information. The method can be extended to calculation of the performance measures defined by CCIR. ESA

N93-23379# University Coll., London (England). Dept. of Electronic and Electrical Engineering.
A LEAKAGE CANCELLER FOR A SINGLE ANTENNA RADAR M.S. Thesis
David A. Green 1991 74 p Sponsored by Ministry of Defence Procurement Executive, London, England
(ETN-93-93495) Copyright Avail: CASI HC A04/MF A01

A description of the construction and testing of a dynamic cancelling system designed to alleviate the problems inherent in using a single antenna radar system, specifically those of circulator leakage causing receiver desensitization, is presented. The system was constructed at X band using components available in the laboratory, and all the required electronics were fabricated using standard and readily available components. Results are presented demonstrating that the canceller works over a very narrow bandwidth (approximately 40 to 50 MHz at X band). The design of a mixer to be used at Ka band (13.5 GHz) is described. The mixer was intended to be the primary element in a similar type of cancelling circuit to be used in the MSSL short range scatterometer, which is part of the ERS-1 European remote sensing satellite calibration and validation program. ESA

N93-23458# Defence Research Establishment, Ottawa (Ontario).
EFFECT OF CODE AUGMENTATION OR TRUNCATION ON THE SIGNALS PRODUCED BY A TIME-INTEGRATING CORRELATOR
N. Brousseau Oct. 1992 80 p
(AD-A259802; DREO-92-11) Avail: CASI HC A05/MF A01

The characteristics of the signals produced by a time-integrating correlator when processing augmented or truncated code are analyzed. It deals specifically with the description of the peak trains generated by either the autocorrelation of the modified code, the cross-correlation of the modified code with the original code, or the cross-correlation of the modified code with a test code of the same length. It is demonstrated that the complex peak patterns thus generated contain information about the modification of the code and that it is possible to retrieve that information by applying specific processing methods. Four processing methods are proposed. The first method extracts information from the peak patterns generated by the autocorrelation of the modified signal. The second method uses the cross-correlation of the modified signal with the original signal while the third method deals with the cross-correlation of the modified code with a test code that has the same length as the modified code. The fourth method allows the determination of the initial fill of truncated codes when the signal-to-noise ratio is sufficiently good. GRA

N93-23504 New York Univ., New York.
METHODOLOGY DEVELOPMENT FOR THERMAL ANALYSIS OF SPACE POWER MICROWAVE RECTIFYING ANTENNAS (RECTENNAS) Ph.D. Thesis
Murali Natarajan Kadiramangalam 1992 164 p
Avail: Univ. Microfilms Order No. DA9237947

Beaming power at microwave or millimeter wave frequencies is a means of transmitting power in air or vacuum. The reception and DC power conversion device is called a rectenna (element). To date rectennas

have been designed either for powering aircraft or for solar power satellites. Use of rectennas in space missions will entail incident power densities greater than previously envisioned. This, coincident with absence of convective energy dissipation may result in temperatures above design limits. Thus it is necessary to predict the temperatures both globally (spatially) and locally (detailed) for rectenna element arrays. In this thesis such a methodology is developed with specific numerical results typical of space missions in earth orbit, including incident solar and albedo fluxes and radiative heat dissipation to 0 K. A rectenna is comprised of subarrays, and in turn single unit cells - the smallest repeating element. The unit cell contains a diode which converts incident microwave to DC; inefficiencies result in a localized heat source. The heat conduction equation is solved numerically in this unit cell. Since the unit cell boundaries are not coincident with the lines of symmetry, the solution is also obtained by 'shortening' the cell boundaries. This provides the local solution, but to provide the global solution (including Joule heating) the heat conduction equation is solved for a three unit cell array. These analyses are performed for both a detailed 3D and simple quasi 1D representation. Comparing results of the detailed and simple representations for a unit cell, a shorted unit cell and a three unit cell array; a methodology is developed and demonstrated to be accurate for arbitrary size arrays. These calculations were performed for a 2.45 linear polarized (LP) rectenna. The major conclusions are: the methodology developed is general and can readily be applied to the thermal design of higher frequency rectennas, where the temperature calculation is critical; and 2.45 LP rectenna diode temperatures are excessive and this rectenna needs to be redesigned. Dissert. Abstr.

N93-23598# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.
RADIOLOCATION TECHNIQUES [LES TECHNIQUES DE RADIOLOCALISATION]
Nov. 1992 346 p Symposium held in London, England, 1-5 Jun. 1992 Original contains color illustrations
(AGARD-CP-528; ISBN-92-835-0695-2) Copyright Avail: CASI HC A15/MF A03

Modern defense systems must have a comprehensive surveillance capability. A key component of a surveillance system is the ability to detect and to locate radio signals in the entire radio spectrum from extremely low frequencies through millimeter wavelengths. Various techniques are used to determine the angle of arrival of a radio signal and the distance to the source. This often involves complex signal processing techniques. The symposium addressed first propagation aspects with emphasis on ionospheric characteristics and effects. Two sessions were devoted to the description of radio location techniques such as single site location and another two to radio location measurements and systems. One session covered signal processing techniques in radio location applications. One session covered classified subjects and will be published in a classified addendum. For individual titles, see N93-23599 through N93-23631.

N93-23599# Wait (James R.), Tucson, AZ.
LATERAL DEVIATION OF VLF RADIO WAVES DUE TO DIFFRACTION AND SCATTERING FROM COAST-LINES, MOUNTAIN RANGES, AND POLAR ICE CAPS
James R. Wait *In* AGARD, Radiolocation Techniques Nov. 1992 12 p (For primary document see N93-23598 08-32)
Copyright Avail: CASI HC A03/MF A03

This paper deals with a physical theory of radio wave propagation in the earth ionosphere waveguide when allowance is made for lateral non-uniformities in the lower boundary. A combined hybrid ray and mode analysis is adopted which reduces to the now conventional formulation when the lower boundary is uniform. For obvious reasons, the mathematical details will not be presented but the optical interpretation is given and the physical concepts are illustrated in a meaningful fashion. A case of particular interest is when the global propagation of the VLF signal arrives from both the direct path as well as a sometimes very strong resonant scatter from a continental mountain range 1000 km or more off the great circle path. Other examples occur when the signal actually diffracts around convex coast-lines and continental margins such as the Antarctic ice cap. In such cases, the direct path signal over the highly lossy medium is highly attenuated and may be out of contention. In the simplest theory of 'horizontal bending' of VLF wave guide modes, the conversion of modes, of one order to another, is ignored. But, by employing mode match techniques, the conversion of modes of order m to modes of order n (reflected) and to modes of order p(transmitted) can be estimated. Both a scalar and a vector version of the formulation are outlined. Actually the scalar version is really more appropriate for dealing with acoustic ducts with inhomogeneous walls when the horizontal direction of propagation is oblique to the junction planes. Strictly speaking the full blown vector problem must be dealt with in the electromagnetic case if proper allowance is to be made for the inevitable coupling between the TM (transverse magnetic) and TE (transverse magnetic) modes. Author (revised)

N93-23600# Phillips Lab., Hanscom AFB, MA. Geophysics Directorate.
PROPAGATION CHARACTERISTICS OF THE IONOSPHERIC TRANSMISSION WINDOW RELATING TO LONG WAVE RADIO LOCATION ISSUES
Paul A. Kossey and Edward A. Lewis (Systems Integration Engineering, Inc., Lexington, MA.) *In* AGARD, Radiolocation Techniques Nov. 1992 17 p (For primary document see N93-23598 08-32)
Copyright Avail: CASI HC A03/MF A03

Most applications of long radio waves (ELF/VLF/LF/MF) are ground-based and exploit the fact that such signals can propagate to great distances via reflections from the lower ionosphere. It is known however that, owing to the influence of the earth's magnetic field, long wave signals can penetrate through the ionosphere as well; at times, the waves penetrate with relatively little loss, depending on ionospheric conditions and other propagation factors. This has prompted investigations of the long wave 'ionospheric transmission window' as part of efforts to assess the feasibility of deploying long wave emitters in space for terrestrial applications and/or for exploiting, in space, signals emanating from ground-based long wave transmitters. This paper outlines results of theoretical and experimental investigations of the ionospheric transmission window over the frequency range from about 100 Hz to 500 kHz, with emphasis on directional issues associated with long wave penetration of the ionosphere. Author (revised)

N93-23601# General Research Corp., Albuquerque, NM.
THE EFFECTS OF MULTIPATH SCATTER FROM WIND DRIVEN GRAVITY WAVES ON LINES OF BEARING SERVING AS DIRECTION FINDERS
R. H. Ott *In* AGARD, Radiolocation Techniques Nov. 1992 6 p (For primary document see N93-23598 08-32)
Copyright Avail: CASI HC A02/MF A03

Unambiguous locations for target transmitters are based on lines of bearing (LOB's) obtained by radio direction finding (DF) methods. These target location estimates based on intercepted LOB's are subject to error if multipath exists. This multipath may result from sky wave interference or sea scatter from rough seas. Sky wave multipath becomes important for ranges greater than 300 km while ground wave multipath may be significant for ranges less than about 100 km. Although, the groundwave loss may be greater than the one-hop sky wave mode, it may be comparable to the loss associated with the two-hop mode. Therefore both groundwave and sky wave multipath may contribute to LOB errors for a given fleet exercise. For the case of sky wave multipath, newer DF systems will be able to differentiate sky wave signals from ground wave signals when the elevation angle is greater than about 18 deg. In this paper, groundwave multipath is estimated using the compensation theorem. This method provides a convenient analytical tool for relating the change in mutual impedance between a transmitting monopole and a receiving loop over a rough sea surface and a flat sea. The change in mutual impedance, in turn, is related to the change in current in each of the receiving loops used to generate LOB's. Some predicted and observed examples of fleet exercise LOB errors from wind generated swell will be given based on target transmitter frequency, wind direction, and speed of the ship carrying the DF system. Author (revised)

N93-23602# Syracuse Research Corp., NY.
PROPAGATION EFFECTS ON HF DIRECTION FINDING
George H. Millman *In* AGARD, Radiolocation Techniques Nov. 1992 12 p (For primary document see N93-23598 08-32)
Copyright Avail: CASI HC A03/MF A03

Estimates are made of the propagation errors that can be made in the measurement of the geographic coordinates of an HF emitter when utilizing HF direction finding techniques. The sources of the errors considered in

this analysis are those due to the following: (1) imprecise knowledge of the ionospheric reflection height; (2) ionospheric tilts, i.e., gradients of electron density; and (3) tropospheric refractive bending. Author (revised)

N93-23603# Paris-Sud Univ., Orsay (France).
NEW METHOD OF MODELLING THE MESOSCALE STRUCTURE OF THE IONOSPHERE WITH A SINGLE SENSOR. IMPACT ON HF RADIO-LOCATION [NOUVELLE METHODE DE MODELISATION MESO-ECHELLE DE L'IONOSPHERE A PARTIR D'UN SITE UNIQUE. APPLICATION A LA RADIOLOCALISATION HF]
J. L. Mokrzycki, L. Barthes, J. Caratori, and C. Goutelard *In* AGARD, Radiolocation Techniques Nov. 1992 13 p In FRENCH (For primary document see N93-23598 08-32)
Copyright Avail: CASI HC A03/MF A03

Modeling of the ionosphere is a necessity in numerous applications: the physical study of an area, telecommunications, transhorizon radars, and radio location. Radio location from a single sensor is particularly attractive but requires, in the decametric propagation range, knowledge with a sufficient precision of the ionospheric area within which the trajectories of the radii are controlled, not only by the vertical profile of the ionization, but also by the horizontal gradient. A tracing of a radius in an ionosphere is investigated by making use of a Bradley-Dudeney model in the presence of horizontal gradients whose transversal components are not null. One can see that the components draw the propagations outside of a large circle with important deviations on the ground due to the reflection occurring in region F. Taking into account these gradients is indispensable for a correct location, which makes their estimation necessary. Radio location from a single sensor necessitates therefore the placement in the same location of a means of measurement. A retrodiffusion probe easily brings anisotropies to light. It represents a simple means which is possible to put to work with very little power and is therefore attractive. The principal difficulty of this technique is in the resolution of an inverse problem which, aside from the measurements obtained, permits the discovery at all points of the observation zone of the vertical profile from which the gradients are deduced. It is a difficult problem which has not yet really received a totally satisfactory solution in spite of important efforts produced by the scientific world. The stabilization of the solution appears to be possible thanks to new techniques which allow the measurement of new parameters. The angle of elevation of retrodiffused radii is one of these parameters, the importance of which was predicted during the 1960's. The utilization of this parameter, together with the data furnished by a retrodiffusion probe, permitting the observation of all azimuths, is developed in this presentation. Author (revised)

N93-23604# Rome Lab., Hanscom AFB, MA. Electromagnetics and Reliability Directorate.
THE SPATIAL AND TEMPORAL CHARACTERISTICS OF HIGH FREQUENCY AURORAL BACKSCATTER
D. S. Choi, Bert Weijers, R. J. Norris, and N. B. Myers *In* AGARD, Radiolocation Techniques Nov. 1992 10 p (For primary document see N93-23598 08-32)
Copyright Avail: CASI HC A02/MF A03

Preliminary results from the measurements of high frequency (HF) backscattered signals from the auroral ionosphere using the Verona-Ava Linear Array Radar (VALAR) system are presented. VALAR is an experimental HF backscatter system capable of obtaining high resolution synoptic mapping of HF signals backscattered from field-aligned electron density irregularities in the auroral ionosphere. The receive system includes a 700 meter long linear array, providing the high azimuthal resolution required for determining the spatial distribution of HF auroral backscatter. Since the completion of the system tests and calibration at the end of 1989, experimental campaigns have been carried out on a near-monthly basis. In this paper, we provide a brief description of VALAR and present preliminary measurements of three types of phenomena: ground backscatter, slant-F, and auroral backscatter. Author (revised)

N93-23605# Boston Univ., MA. Center for Space Physics.
THE LONGITUDINAL OCCURRENCE OF EQUATORIAL F LAYER IRREGULARITIES
Jules Aarons *In* AGARD, Radiolocation Techniques Nov. 1992 12 p Sponsored by ONR (For primary document see N93-23598 08-32)
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Determining the morphology of F layer irregularities as a function of longitude in the equatorial region is vital for understanding the physics of the development of these irregularities. We aim to lay the observational basis which then can be used to test theoretical models. The question is whether the models are consistent with the morphology as we see it. According to our criteria, the data used should be confined to observations taken near the magnetic equator during quiet magnetic equator during quiet magnetic periods and at times within a few hours after sunset. Anomaly region data should be omitted for studying the generation mechanism. The questions to be answered by proposed mechanisms are (1) why do the equinox months have high levels of occurrence over all longitudes?; (2) why are there relatively high levels of occurrence in the Central Pacific Sector in the Jul.-Aug. period and in the 0-75 degree West Sector in the Nov.-Dec. period?; and (3) why are these very low levels of occurrence in Nov. and Dec. in the Central Pacific Sector and in Jul. and Aug. in the 0-75 degree West Sector? Satellite in-situ data, scintillation and spread F observations are reviewed. The limitation of each data set is outlined particularly as relevant to the bias produced by the existence of thin versus extended layers of irregularities. A cartoon of the occurrence pattern, as we see it, as a function of longitude is shown.

Author (revised)

N93-23606# Nebraska Univ., Lincoln. Dept. of Electrical Engineering.
IRREGULAR MEDIA EFFECTS ON RADIOWAVE SIGNALS USED IN NAVIGATION AND POSITIONING SYSTEMS
Ezekiel Bahar *In* AGARD, Radiolocation Techniques Nov. 1992 12 p (For primary document see N93-23598 08-32)
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Radiowave signals, over a very broad range of frequencies, are used extensively in navigation and propagation systems. These signals that propagate to very large distances from the transmitter across the earth's surface or through the ionosphere are significantly affected by media irregularities. Some of these irregularities are fixed while others fluctuate due to, for instance, the diurnal variations in the ionosphere. The magnitude and phase of CW signals are affected by the medium through which they propagate. Since these effects are frequency dependent, transient (pulsed) signals also undergo distortions and delays, which have a very significant impact on navigation and positioning systems. Thus, when CW signals are used for navigation or positioning, it is necessary to predict the deviations in the phase of the received signals (phase anomalies) due to medium effects. When pulsed signals are used for navigation and positioning, it is necessary to predict the signal delays due to the medium effects. Moreover, for given propagation paths, it is necessary to avoid the use of carrier frequencies that are more prone to signal distortions which make it very difficult to predict the time of arrival of the radio signals. It is necessary to obtain accurate predictions of the received signals as the demands on the navigation system become more stringent. Thus, for most relevant propagation problems, it is not sufficient to use idealized models of the propagation medium. The models that need to be considered consist of layers of nonuniform thickness with varying electromagnetic parameters. Since the ionosphere also needs to be considered, the medium is generally considered to be both inhomogeneous and anisotropic. For these irregular models of the curved earth-ionosphere propagation environment, it is not possible to obtain standard separable solutions for the propagation problem. Furthermore, since the solutions should be valid for a very broad range of radio frequencies, the physical/geometrical optics (high frequency) approach or the small perturbation (low frequency) approach cannot be used in general. In this work, a full-wave approach is described in detail. Radio wave propagation over irregular propagation paths is examined in detail. The phase anomalies and pulse delays and distortions for radio signals transmitted across hills and valleys on the earth's surface or over the oceans and through irregular layered models of the earth's crust and the ionosphere are determined using the full-wave approach. Author

N93-23607# Rennes Univ. (France). Lab. Radiocommunications.
THE INFLUENCE OF PROPAGATION ON HIGH FREQUENCY RADIOGONIOMETRY AND SINGLE STATION LOCATION [INFLUENCE DE LA PROPAGATION SUR LA GONIOMETRIE HAUTE FREQUENCE ET LA LOCALISATION A STATION UNIQUE]
V. Baltazart, L. Bertel, and R. Fleury (Centre National d'Etudes des

Telecommunications, Lannion, France.). *In* AGARD, Radiolocation Techniques Nov. 1992 13 p In FRENCH (For primary document see N93-23598 08-32)
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This paper deals with some propagation effects which can influence Single Station Location systems. We consider first, the direct problem which consists of estimating several directions of arrival of the incoming waves. For this purpose and for a given state of the ionospheric medium, the angles of all propagation paths and modes are determined. In a second step, the simplified model of waves coming from the ionosphere which has been developed before, permits us to simulate the behavior of radiogoniometers. We analyze the performance of goniometric systems based upon interferometry, data processing, and space-time processing. Proximity in such propagation modes leads to the addition of a polarization filtering procedure. The problem in reverse consists of locating the emitter thanks to the previous radiogoniometry results. We look at the effect of an imperfect knowledge of the profile, before introducing two SSL methods: the first dealing with vertical sounding results; and the second works from a partial updating profile. We also give an example of an influence of tilt.
Author

N93-23608# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Ionospheric Branch.
A CURRENT ASSESSMENT OF SINGLE SITE LOCATING TECHNOLOGY
Robert B. Rose *In* AGARD, Radiolocation Techniques Nov. 1992 8 p (For primary document see . N93-23598 08-32)
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This paper describes the observed performance of a HF Single Site Locator (SSL) which employs current interferometer technology. One hundred and forty two locations were obtained from non-cooperative targets over a five day period in April 1989. Locations were determined from fast, high resolution azimuth and elevation angle of arrival measurements and a knowledge of the ionospheric reflecting medium. Exact emitter locations were determined post facto with ground truth data from the field units. Five modes of transmission were encountered and the signals were successfully located. Miss distance accuracies varied between 12.5 kilometers to 40.5 kilometers over ranges that varied from 109 kilometers to 526 kilometers. Performance varied as a function of modulation type with SSB voice being the most difficult to prosecute and packet, and burst signals were the easiest to locate. Also, performance varied as a function of range and the relationship of the operating frequency to the maximum usable frequency between the SSL and the target.
Author

N93-23609# Southwest Research Inst., San Antonio, TX. Electromagnetics Div.
A NEW PASSIVE SSL TECHNIQUE FOR HF RADIOLOCATION
R. L. Johnson, Q. R. Black, and A. G. Sonsteby *In* AGARD, Radiolocation Techniques Nov. 1992 8 p (For primary document see N93-23598 08-32)
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This paper considers the problem of passive radio location for the case of HF multipath propagation. A new technique is developed for the estimation of interpath time delay applying an eigen based super-resolution spectral estimation method. The technique samples the wavefield received by two spatially separated antennas to compute intersensor delay time for each constituent signal through a normalized eigen cepstral analysis. The intersensor delays and interpath delay are used in concert to estimate the location of the transmitter. The method is applied to experimental data in a preliminary proof-of-concept analysis.
Author

N93-23610# Andrew SciComm, Inc., Garland, TX.
PROCEDURES FOR DETERMINING THE LOCATION OF AN HF RADIO TRANSMITTER
Leo F. McNamara *In* AGARD, Radiolocation Techniques Nov. 1992 12 p (For primary document see N93-23598 08-32)
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The location of an HF transmitter may be derived by either of two methods, depending on what observations of the target transmitter are available. In the traditional approach currently adopted for strategic DF networks, the location is determined by triangulation using Lines of Bearing (LOB) of the signals observed at two or more HF-DF sites. This approach is called the LOB approach. Alternatively, the location may be derived by observations at a single DF site, if the observations are extended to include that of the elevation angle as well as the bearing of the incoming radio waves. Triangulation in the vertical plane containing the observed LOB, using a model of the propagation medium (the ionosphere), leads to an estimate of the position of the target transmitter. This approach is known as the Single Site Location (SSL) method. The success of the LOB approach depends heavily on two or more DF sites being able to hear and process the signals from the target transmitter, as well as on having reasonably favorable geometries. When these conditions are not met, the LOB approach fails. The SSL method, on the other hand, is applicable under almost all conditions. This paper, therefore, compares and contrasts the two approaches to determining the location of an HF transmitter. The relative advantages of the SSL approach are shown to be such that all HF-DF sites should logically be SSL sites.
Author

N93-23611# Defence Research Establishment, Ottawa (Ontario).
HIGH RESOLUTION SAMPLED APERTURE ARRAY DIRECTION FINDING AT HF
T. N. R. Coyne *In* AGARD, Radiolocation Techniques Nov. 1992 8 p (For primary document see N93-23598 08-32)
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A simple parametric target model fitting algorithm that gives a least squares fit to the observed in-phase and quadrature data across a linear sampled aperture array is outlined. The performance of this algorithm with various simulated signals and noise levels is presented. In particular, it is shown that this approach is quite robust in the presence of noise. The algorithm was developed for the analysis of data obtained on a large HF sampled aperture receiving array operated near Ottawa. An example of this analysis is given. In this instance, a long range signal exhibiting typical ionospheric fading (on individual array elements) is shown to be resolvable into three stable, coherent components spread over a 2.5 degree arc.
Author

N93-23612# GEC-Marconi Electronics Ltd., Chelmsford (England).
DETECTION OF ACTIVE EMITTERS USING TRIANGULATION AND TRILATERATION TECHNIQUES: THEORY AND PRACTICE
A. M. Dean *In* AGARD, Radiolocation Techniques Nov. 1992 7 p Sponsored by Defence Research Agency (For primary document see N93-23598 08-32)
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Recent conflicts have highlighted the benefits of 'soft-kill' electronic warfare (stand off, escort, and self screening jamming), during intrusion into areas protected by Air Defence (AD) radar networks. These conflicts have highlighted the need to protect and supplement the Recognized Air Picture (RAP) with the ability to locate and track the intruding jammers. A Passive Jammer Location (PJL) system, and some of the theory behind it, currently under development at the Marconi Research Center are described. The two basic geometrical techniques for locating unknown emitters, usually termed triangulation and trilateration, are identified. The main problems associated with triangulation techniques, those of target ghosts and ghost resolution in denser scenarios, are discussed and trilateration processing using correlation offered as a solution. The main feature of an operational PJL system is noted as being the need to positively resolve jammer positions, to sub-beam accuracy, in dense jamming scenarios. This includes the 'pop-up' target appearing over the radar horizon and the agile sophisticated jammer. In addition a number of other features are identified which would be desirable in any future NATO PJL system. Over a number of years the UK MoD and GEC-Marconi have undertaken a number of studies relating to PJL architectures and data processing techniques. In 1991 these studies led to the Air Defence Emitter Location Equipment (ADELE) Technology Demonstrator. The objectives of the ADELE program are to demonstrate that the requirements of a PJL system can be met at a price affordable by AD system procurers. Additionally to confirm that the new PJL data processing techniques, developed during these previous studies, perform as predicted during live trials. The main hardware and software modules making up the ADELE demonstrator are discussed including: the multi beam antenna, the resistive matrix beam former, the PJL multi-channel signal sampling hardware, radar interfaces and synchronization, signal and data processing, display and recording, and simulation resources.
Author (revised)

N93-23613# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Ionospheric Branch.

RADIOLOCATION OF A SATELLITE-BORNE LOVHF BEACON

Robert B. Rose *In* AGARD, Radiolocation Techniques Nov. 1992 6 p (For primary document see N93-23598 08-32)

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A year long experimental program was conducted to measure refractive bending, or how much the signal deviates from true line of sight, at low VHF frequencies (29.5 MHz), and to determine whether this deviation or error could be predicted using large scale ionospheric models such as the Ionospheric Conductivity and Electron Density (ICED) program. An experiment to directly measure the angle of arrival of a 29.5 MHz signal from an orbiting satellite was successfully completed. The satellite was in a circular orbit at an altitude of 1000 km. It was shown that refractive errors can be directly related to the electron density along the measurement slant range. Ionospheric disturbances such as sporadic E and ionospheric storms produce large, short term errors that can approach 10 degrees. In addition to day/night variations, seasonal and solar cycle sensitivities were found. The refractive error varied so' rapidly with respect to time and space that its prediction with a median value ionospheric code is almost impossible. Author

N93-23614# Leicester Univ. (England). Dept. of Physics and Astronomy.

SYSTEMATIC BEARING ERRORS OF HF SIGNALS OBSERVED OVER A NORTH-SOUTH PROPAGATION PATH

T. B. Jones, E. M. Warrington, and J. E. Perry (Department of Defense, Washington, DC.) *In* AGARD, Radiolocation Techniques Nov. 1992 5 p (For primary document see N93-23598 08-32)

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Strong gradients in electron density associated with sunrise and sunset are a well known feature of the ionosphere and will produce off great circle bearings, particularly if the propagation path is parallel to the dawn or dusk terminator. Measurements were undertaken of the direction of arrival of signals in the range 3 to 23 MHz radiated by a transmitter located at Clyde River in the Canadian Arctic (70 deg N, 70 deg W). The path from this transmitter to the receiving site at Boston, USA, is parallel to the dawn dusk line and consequently systematic changes in bearings are expected to occur. Bearings measured during January 1989 indicate a positive error of a few degrees at around sunrise. As the day progressed the error decreased, becoming zero at local noon at the path mid point. As the dusk approaches, the tilts in the ionosphere are reversed in gradient and there is a smaller negative swing in the mean bearing. The bearing error at dusk is smaller than at sunrise since the ionospheric gradients at this time are less steep. The diurnal swing in the bearing occurs during the winter and equinox periods but is absent (or very small) during summer. This is because the ionospheric gradients in summer are smaller than those at other seasons due to the relatively low values of the F-region critical frequency (foF2) which occur during the summer daytime. Author (revised)

N93-23615# Leicester Univ. (England). Dept. of Physics and Astronomy.

LARGE BEARING ERRORS OBSERVED AT A HIGH LATITUDE DF SITE

T. B. Jones and E. M. Warrington *In* AGARD, Radiolocation Techniques Nov. 1992 10 p Sponsored by Dept. of National Defence (For primary document see N93-23598 08-32)

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It is well known that the auroral zone ionosphere contains steep time varying gradients in electron density which can produce large off-great circle bearings in the direction of arrival of HF radio signals reflected from this region of the ionosphere. Recent DF measurements at a high latitude site indicate that large bearing errors are also observed in signals reflected from the polar cap ionosphere which is generally regarded as being a much less disturbed region than the auroral zone. A feature of these measurements is a large (+ or - 50 deg) quasi-periodic swing in the direction of arrival observed for both short and long propagation paths. These changes in angle of arrival are attributed to reflection from patches or 'blobs' of over-dense plasma which travel with the convection current flow across the polar cap region from dayside to nightside. The periods of large bearing swings are well correlated with the onset of magnetic activity as measured by the Kp index. Author (revised)

N93-23616# Leicester Univ. (England). Dept. of Engineering.

MEASUREMENTS OF THE DIRECTION OF ARRIVAL OF AN OBLIQUE CHIRP SOUNDER SIGNAL

E. M. Warrington, T. B. Jones, and P. Hamadyk *In* AGARD, Radiolocation Techniques Nov. 1992 10 p Sponsored by Dept. of National Defence (For primary document see N93-23598 08-32)

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The performance of high frequency (HF) direction finding systems is related to the mode content of the received signal and to the signal frequency. In order to fully investigate this effect, an experiment was devised to measure the direction of arrival of oblique ionospheric sounding signals emitted by the worldwide network of BR Communications chirp sounders. These signals are radiated as a constant sweep chirp signal from 2 to 16 or 30 MHz thus enabling the DF performance to be measured over the full range of frequencies propagating from the chosen transmitter. Simultaneous oblique ionograms are also recorded for the paths of interest in order to determine the mode structure at any frequency. Preliminary tests of the system were undertaken at Ottawa, Canada and Cheltenham, UK with the directions of arrival measured by a wide aperture goniometric DF system. Several interesting features were identified in these measurements. A further measurement campaign was conducted during Apr. 1992 at Alert, a very high latitude site in the Canadian Arctic where very large bearing errors and systematic bearing swings, sometimes in excess of + or - 50 deg, are known to occur. Author (revised)

N93-23617# Leicester Univ. (England). Dept. of Engineering.

BEARING DETERMINATION AND BEARING QUALITY INDICATION FROM A GONIOMETRIC HF DF SYSTEM

E. M. Warrington and T. B. Jones *In* AGARD, Radiolocation Techniques Nov. 1992 11 p Sponsored by Dept. of National Defence (For primary document see N93-23598 08-32)

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A computer based model of an automated wide aperture goniometric HF direction finder (type DF6) was developed to investigate the system performance under various simulated signal environments. Several test runs of the model indicated that the original DF6 algorithm could be modified to yield a significant improvement in the measured bearing accuracy and in addition provide a meaningful indication of the quality of the measured bearing. These modifications were implemented and tested at two sites in Canada. A system located in Ottawa was tasked against known transmissions from Halifax, Nova Scotia (950 km) and several hours of data collected. These measurements confirmed that the changes implemented as a result of the computer modeling produced improved bearing measurements. Further tests were conducted at Alert, a very high latitude site in the Canadian Arctic. At this site, the bearings often varied rapidly by several tens of degrees. These latter observations indicated that further changes to the DF algorithm should be made for systems deployed at this high latitude sight. Author

N93-23618# Massachusetts Univ., Lowell. Center for Atmospheric Research.

ANGLE OF ARRIVAL CHARACTERISTICS OF IONOSPHERIC SKYWAVE SIGNALS

D. Mark Haines and Bodo W. Reinisch *In* AGARD, Radiolocation Techniques Nov. 1992 6 p Original contains color illustrations (For primary document see N93-23598 08-32)

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Skywave signals in the HF band experience a plethora of effects which distort them in the time, space, and spectral domains. The ability of a particular measurement to resolve discrete components which faithfully represent a single signal source (i.e., useful for angle-of-arrival estimation) is a somewhat random occurrence given any one fixed integration time. However, the fact that the signal components can be resolved in the spectral domain by our Doppler technique much of the time seems to indicate that there are indeed a finite number of discrete components in any sky wave signal and that the Doppler shift for each component varies independently such that they may be resolvable in the spectral domain. Author (revised)

N93-23619# Centre National d'Etudes des Telecommunications, Lannion (France).

UTILIZATION OF A RECEPTION NETWORK OF THE LOSQUET ISLAND RETRODIFFUSION PROBE IN RADIOGONIOMETRY [UTLISATION DU RESEAU DE RECEPTION DU SONDEUR A RETRODIFFUSION DE L'ILE LOSQUET EN RADIOGONIOMETRIE]

J. Y. LeSaout, F. Gauthier, N. Ruelle, and R. Fleury *In* AGARD, Radiolocation Techniques Nov. 1992 11 p In FRENCH (For primary document see N93-23598 08-32)

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The method of radiogoniometry from a single sensor operating from the Losquet Island retrodiffusion probe is described. The experimental results of the determination of the azimuth and the elevation of the waves having transitioned through the ionosphere, obtained by well-located emitters, are presented. The measured angles are compared to the results from a propagation model and to the arrival directions calculated by an oblique transposition of vertical ionograms. It is shown that the azimuth in which the emitter is found can be determined with a precision which is that of the accuracy of the measurement, and at elevation, the method allows the measurement of the angles associated with the dominant trajectories even if their performances are limited in the presence of multitrajectories.

Transl. by FLS

N93-23620# NAVSYS Corp., Colorado Springs, CO.

TEST RESULTS OF THE ADVANCED TRANSLATOR PROCESSING SYSTEM

Alison K. Brown, William Sward, and Peter Brown *In* AGARD, Radiolocation Techniques Nov. 1992 12 p (For primary document see N93-23598 08-32)

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The Advanced Translator Processing System was developed to provide a low cost alternative to tracking translated GPS signals. It is backwards compatible with the Translator Processing System (TPS) currently used to track Ballistic Missile Translators (BMT) by the US Ranges. NAVSYS has also developed a BMT compatible Translator. A key element of the ATPS is the Preamplifier/Downconvertor (P/DC) module which was developed by NAVSYS to condition the received Translator signal so it can be tracked with a conventional C/A code receiver. This significantly reduces the cost of the hardware by allowing the ATPS to be constructed mostly from off-the-shelf components. The ATPS and Translator were tested against the RAJPO Ballistic Missile and Translator Processing System Specifications. This paper presents the results of tests demonstrating the performance of the ATPS and Translator under different operating conditions. NAVSYS has also developed a Post Test Processing System (PTPS), incorporating the same components, which records the Translator data during the tests. When this data is played back, high-accuracy Time and Space Position <iformation (TSPI) data can be computed on the vehicle even under extreme dynamics. Author

N93-23621# Shape Technical Center, The Hague (Netherlands). Communications Div.

COMMUNICATION INTERFERENCE/JAMMING AND PROPAGATION ANALYSIS SYSTEM AND ITS APPLICATION TO RADIO LOCATION

H. Kuzucu *In* AGARD, Radiolocation Techniques Nov. 1992 14 p (For primary document see N93-23598 08-32)

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Modern defense systems depend on comprehensive surveillance capability. The ability to detect and locate the radio signals is a major element of a surveillance system. With the increasing need for more mobile surveillance systems in conjunction with the rapid deployment of forces and the advent of technology allowing more enhanced use of small aperture systems, tactical direction finding (DF) and radiolocation systems will have to be operated in diverse operational conditions. A quick assessment of the error levels expected and the evaluation of the reliability of the fixes on the targeted areas bears crucial importance to the effectiveness of the missions relying on DF data. This paper presents a sophisticated, graphics workstation based computer tool developed for the system level analysis of radio communication systems and describes its use in radiolocation applications for realizing such accurate and realistic assessments with substantial money and time savings. Author

N93-23622# Alenia, Torino (Italy). Settore Sistemi Difesa.

AIRBORNE SYSTEM FOR DETECTION AND LOCATION OF RADIO INTERFERENCE SOURCES

Bruno Audone and Alberto Pastore *In* AGARD, Radiolocation Techniques Nov. 1992 12 p (For primary document see N93-23598 08-32)

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The rapid expansion of telecommunication has practically saturated every band of Radio Frequency Spectrum; a similar expansion of electrical and electronic devices has affected all radio communications which are, in some way, influenced by a large amount of interferences, either intentionally or unintentionally produced. Operational consequences of these interferences, particularly in the frequency channels used for aeronautical services, can be extremely dangerous, making mandatory a tight control of Electromagnetic Spectrum. The present paper analyzes the requirements and the problems related to the surveillance, for civil application, of the Electromagnetic Spectrum between 20 and 1000 MHz, with particular attention to the detection and location of radio interference sources; after a brief introduction and the indication of the advantages of an airborne versus ground installation, the airborne system designed by Alenia in cooperation with Italian Ministry of Post and Telecommunication, its practical implementation and the prototype installation on board of a small twin turboprop aircraft for experimentation purposes is presented. The results of the flight tests are also analyzed and discussed. Author (revised)

N93-23623# Aerospatiale, Magny-Les-Hameaux (France). Service DE/ETRI.

LOCALIZATION SYSTEM BASED ON DATA MERGING OF IMAGES AND INERTIA

J. Y. Cartoux, G. Sella, L. Agranier, T. Pechoux, and G. Grenier *In* AGARD, Radiolocation Techniques Nov. 1992 4 p (For primary document see N93-23598 08-32)

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The accuracy which is now required in the target approach of the modern missiles, requires the use of several sensors. Inertial systems, GPS when available, and imaging sensors are combined to improve the overall accuracy by the means of filtering and data merging techniques. Several tasks can be realized by the imaging system: targets detection and identification, missile position and motion estimation. The resulting information will be used as command parameters under certain conditions of robustness and accuracy. Our goal is not only to compute these parameters but to specify their domain of usability. Our approach is based on the development of a global simulator. The models of the inertial systems, the information computed by the imaging sensors are combined in a global Kalman filter scheme. The goal is to provide the user with the ability of studying the sensibility of the vision algorithms to some system parameters and external conditions in order to get the best overall accuracy. In the first part of this paper, we present the Kalman filter scheme and the issues involved. In the second chapter, the data that can be obtained from imaging techniques and the associated treatments are presented. We specify what are the constraints and the conditions under which these data can be obtained and study their sensibility to some system parameters. Author (revised)

N93-23624# Paris-Sud Univ., Orsay (France). Lab. d'Electronique et de Technologie de l'Informatique.

FRACTAL THEORY FOR LARGE LACUNAR ANTENNA ARRAYS [THEORIE FRACTALE DES GRANDS RESEAUX D'ANTENNES LACUNAIRES]

C. Goutelard *In* AGARD, Radiolocation Techniques Nov. 1992 15 p In FRENCH (For primary document see N93-23598 08-32)

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The complexity of the arrays is directly tied to the number of antennas of which they are composed. The laws of radiation in the far field are well known and are inferred from the law of illumination of the antenna. The worry of the inventor is, as always, to determine, for a number of possible antennas, their spatial partition which assures the most advantageous law of radiation. The electronic orientation of the lobe of the antenna and the functioning within a wide band makes the problem more complex. The desire to obtain a lobe of narrow principal radiation and to limit the amplitude of secondary lobes is always contradictory. Regular structures used fix the characteristics of the diagrams of radiation in which the variations which obey the known laws are less favorable than the optimization of the

diagrams. Aleatory structures can be used, but the correct results are not obtained until after multiple attempts, without which it is possible to be assured that the solution kept is the best. Fractal structures give results which one knows determine, a priori, the characteristics. Certain structures take particularly well to the construction of antennas and permit the best adjustment to finesse the principal lobe and remount the secondary lobes. Particular fractal themes permit the regulation of the problems of arrays in 1, 2 or 3 dimensional space. The fractal structures can be obtained by deterministic processes but also by the introduction of aleatory fluctuations around the deterministic model, which result in pseudo-aleatory fractal structures, or models built by totally aleatory processes which result in fractal aleatory models. Transl. by FLS

N93-23625# Thomson-CSF, Gennevilliers (France). Div. RGS.
LOCATION OF EMISSIONS BY EVASION OF FREQUENCY AND GUSTS BY SEQUENTIAL ANALYSIS SENSOR IN FAST SCANNING [LOCALISATION D'EMISSIONS A EVASION DE FREQUENCE ET RAFALES PAR CAPTEUR A ANALYSE SEQUENTIELLE EN BALAYAGE RAPIDE]
D. Josset *In* AGARD, Radiolocation Techniques Nov. 1992 6 p In FRENCH (For primary document see N93-23598 08-32)
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The use of techniques of transmission by evasion of frequency or gusts in VUHF in order to fight against conventional ECM systems is more and more widespread. The appearance of rapid goniometric sensors makes the interception and goniometry of these signals possible. The localization of these signals by a conventional system requires that the emission be set on standby. In order to avoid this problem, a system of extraction of the emissions with evasion of frequency and gusts with goniometry before localization is proposed, this being carried out on 'synthetic' emissions calculated from goniometric detections. The calculation of these 'synthetic' emissions requires an algorithm allowing the reconnaissance and the identification of the types of emissions. Beginning with the reconnaissance carried out on several goniometers, emitters are sought which have the same characteristics on the various sensors before carrying out localization by the Cartesian least squares method. Transl. by FLS

N93-23626# Lockheed Sanders, Inc., Nashua, NH.
RADIO LOCATION THROUGH HIGH RESOLUTION EIGENSTRUCTURE PROCESSING TECHNIQUES THAT YIELD ACCURATE MULTIPATH AOA AND DIFFERENTIAL TIME DELAY ESTIMATES
Leon M. Lewandowski and Keith A. Struckman *In* AGARD, Radiolocation Techniques Nov. 1992 5 p (For primary document see N93-23598 08-32)
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An eigenstructure based, doubly adaptive array processing algorithm is described. This algorithm resolves the differential time of arrival (DTOA) between the direct signal and a delayed replica that arrives over a different ray path. Simulations, using theoretical responses of a circular eight element dipole array, illustrate the resolving characteristics of the algorithm. Author

N93-23627# Middle East Technical Univ., Ankara (Turkey). Dept. of Electrical and Electronic Engineering.
MULTIPLE EMITTER DIRECTION FINDING FROM A CIRCULAR ARRAY BY SINGLE SNAPSHOT PROCESSING
Y. Tanik and A. Koc *In* AGARD, Radiolocation Techniques Nov. 1992 8 p (For primary document see N93-23598 08-32)
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In this work, a new algorithm for multiple emitter direction finding for circular arrays is proposed. The algorithm uses a single snapshot for processing. The observation is first transformed into frequency domain. Then, by using the Fourier series coefficients of pattern of the sensors, it is transformed into a suitable sequence. The linear prediction method is applied to the resulting sequence to determine the direction of arrivals from the zeros of corresponding linear prediction filter. An iterative correction scheme is used to improve the accuracy of the estimates. Computer simulations have been performed to evaluate the performance of the algorithm. It has been observed that the algorithm operates successfully if the array circumference is comparable to the wavelength. Author

N93-23628# Aerospatiale, Magny-Les-Hameaux (France). Service E/ETRI.
AUTOMATIC FEATURE EXTRACTION AND LOCALIZATION USING DATA FUSION OF RADAR AND INFRARED IMAGES
Stephane Houzelle and Gerard Giraudon (Institut National de Recherche d'Informatique et d'Automatique, Valbonne, France.) *In* AGARD, Radiolocation Techniques Nov. 1992 9 p (For primary document see N93-23598 08-32)
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This paper presents two examples of low level strategies using multi sensor data fusion, one for bridge extraction, and one for urban area extraction. These extractions are made from a couple of coregistered Synthetic Aperture Radar (SAR) and SPOT images. These features are very different by their dimensions, their shape, and their radiometry. Thus we can prove the reliability of our approach on various types of features. Our method uses the notion of complementarity of each sensor, and the notion of context in the observed scene. For bridge detection, we first segment water in the SPOT image, to spatially constrain the bridge research in the SAR image. This research is achieved using a correlation method. To detect an urban area, we first use the knowledge that it produces very bright texture in SAR imagery. Thus, the main part of urban backscatters is extracted using an adaptative thresholding which keeps the upper band of the gray level histogram of the SAR image. This mask is then used for classification as a training mask of urban area texture in SPOT image. We determine the non urban zone training set using a distance map of the urban training zone boundaries. Classification is performed with a multivariate Gaussian classifier. The results we obtained are very encouraging, especially if we consider the robustness of the bridge detection method. Author

N93-23629# Alcatel Espace, Toulouse (France). Ground Systems Dept.
DIGITAL PROCESSING FOR POSITIONING WITH ONE SATELLITE
A. Marguinaud *In* AGARD, Radiolocation Techniques Nov. 1992 12 p (For primary document see N93-23598 08-32)
Copyright Avail: CASI HC A03/MF A03

This paper is a product of theoretical and practical work done with geostationary and low earth-orbiting (SARSAT) satellites. Reliability, efficiency and cost considerations have resulted in an all digital implementation with standard processors. The analog signal is represented by complex samples calculated from real sampling with an algorithm based on an original concept. Any telecommunication (or radar) signal is represented by reversible transformations of a sinusoidal carrier. Maximum likelihood synchronization and demodulation must be used and consists of reconstructing the 'best' carrier from the received signal. Depending on the uncertainty level, one tries a certain number of time-frequency hypotheses, and for each hypothesis, one makes optimum estimations of 3 carrier parameters: modulus, phase and frequency. Since one deals with one circular function, it is straightforward to develop the phase, so that phase and frequency are the 2 parameters defining a straight line in the developed phase-time plane. The 2 corresponding estimators are decorrelated. For a terrestrial vehicle, one can have a good estimation of its velocity, and even for a stationary satellite there is an apparent periodical known motion, which can be used to locate the vehicle by a convenient combination of elementary estimations. Of course some frequency spreading, clock stability and delay are necessary, but explicit performance is easy to derive as functions of operational conditions. Analysis of numerical results may suggest useful practical systems. Author

N93-23630# Kings Coll., London (England). Dept. of Physics.
RADIOLOCATION IN THE LOWER ELF FREQUENCY BAND
C. P. Burke and D. Llanwyn Jones *In* AGARD, Radiolocation Techniques Nov. 1992 9 p (For primary document see N93-23598 08-32) (Grant SERC-SG/D/10351)
Copyright Avail: CASI HC A02/MF A03

A system for recording Extremely Low Frequency (ELF) noise bursts produced by global lightning activity is described. The location of the source lightning flashes for some 320 such events has been deduced from these data. The range of the sources was found by modelling the data using a least-squares fit to the complex wave impedance obtained from the standard propagation theory applicable to the Earth-ionosphere spherical-shell waveguide. The source bearings were deduced from two orthogonal components of the magnetic field vector using the usual goniometric technique. The source range and bearing serve to locate each

source on the surface of the Earth. The data show that the majority of ELF event sources are located in tropical regions, an average of 7.4 Mm away from the observing station situated at 51.14 degrees North, 1.44 degrees West (Geographic). The use of such a system to monitor worldwide thunderstorm activity, so far as this relates to ELF events has been demonstrated. Author

N93-23631# Paris-Sud Univ., Orsay (France). Lab. d'Etude des Transmissions Ionospheriques.

THE WG SEQUENCES: QUASI PERFECT BINARY SEQUENCES [LES SEQUENCES WG: SEQUENCES BINAIRES QUASI PARFAITES]

C. Goutelard *In* AGARD, Radiolocation Techniques Nov. 1992 19 p In FRENCH (For primary document see N93-23598 08-32)

Copyright Avail: CASI HC A03/MF A03

The research of sequences presenting good periodic correlation functions is a subject on which much research has been focussed over a long time. The binary sequences are of particular interest because of their simplicity of generation and of treatment. The W.G. (Wolfmann-Goutelard) sequences presented in this report possess quasi perfect periodic correlation functions, such that outside of the central pic, these functions are null except at one point. It is shown therefore that the structure of W.G. sequences is unique and that it is the result of the interlacing of three periodic sequences. The properties of these sequences are studied and it is shown that the algorithms of determination reduce the complexity of their research. The conditions for the existence, or nonexistence, of these sequences are given and the existing sequences for the lengths N = 8 alpha + 4, N = 16 alpha + 4, and N = 32 alpha + 4 where alpha belongs to Z are given up to N = 20000. Author

N93-23670# Naval Surface Warfare Center, Dahlgren, VA.

TECHNICAL DIGEST. DETECTION SYSTEMS AND TECHNOLOGY, SEPTEMBER 1992

Sep. 1992 147 p

(AD-A259812) Avail: CASI HC A07/MF A02

The Technical Digest is a compilation of reports on detection systems and technology. Topics include: Overcoming the Reduced Radar Cross Section ASM Threat, Refractivity Measurements Using a Vertical Array of Temperature and Humidity Sensors, Top-Level Models for Air Defense and Ship Survivability, Multisensor Integration and Data Fusion in the Surface Navy, A Multisensor Concept for Detection of Low-Flying Targets, ESTAR--Expert System for Track Ambiguity Resolution, Response of the Transfer Function of an Alpha-Beta Filter to Various Measurement Models, A Digital Signal Processor for Improved EMS Bearing Accuracy, Automated Threat Library Support System, The Doppler Spectrum for Accelerating Objects, Directional-Energy Detector Sonobuoy, Wigner-Based Cycle-Rate Detection--Testing on MFSK Acoustic Data, Transient Resonance Scattering for Active Acoustic Classification, Hydrogen Spark Gap for High-Repetition-Rate Compact Accelerators, and Next Generation High-Power Multiple Microwave Sources. GRA

N93-23726# Department of National Defence, Ottawa (Ontario). Surface Radar Section.

APPLICATION OF COSTAS CODES AND QUADRATIC CONGRUENTIAL CODES TO DIGITAL PULSE COMPRESSION [L'APPLICATION DES CODES DE COSTAS ET DES CODES A CONGRUENCES QUADRATIQUES A LA COMPRESSION D'IMPULSION NUMERIQUE]

Caroline Delisle and Martin Blanchette Dec. 1991 28 p In FRENCH

(DREO-TN-91-31; CTN-93-60664) Avail: CASI HC A03/MF A01

Coded signals are used for pulse compression radars, allowing improvement of resolution and target detection without the need to increase peak emitted power. The random selection of a new code at each transmission allows detection of return signals having the same code as that of the transmitted signal while rejecting any other code. It is important to choose codes so that their autocorrelation function has a tight principal lobe and weak secondary lobes, and that their cross correlation is significantly weaker than their respective autocorrelation. Costas codes and quadratic congruential codes, two types of frequency coding, were studied for their application to digital pulse compression. These codes have the characteristics of producing a thumbtack ambiguity diagram with low sidelobes. Computer simulations were performed to calculate their autocorrelation functions, and the performance of the two codes was compared to that of other well-known codes. Results show that the two codes do not have sidelobes as low as those using the chirp, step-chirp, or pseudorandom codes. The quadratic codes are appropriate for an application requiring a compromise between a good autocorrelation function and a good cross correlation. CISTI

N93-23729# Royal Military Coll. of Canada, Kingston (Ontario). Dept. of Electrical and Computer Engineering.

PERFORMANCE ANALYSIS OF THE DOWNLINK DBPSK EHF-SATCOM SYSTEM, PART 1

France Couture and Y. T. Chan Jan. 1991 75 p

(Contract DSS-1410FE62)

(DREO-CR-041LM; CTN-93-60710) Avail: CASI HC A04/MF A01

The downlink phase shift keying system, part of the SATCOM project, was simulated by a computer model. The installation procedure, including data backup and retrieval, for the computer program is presented. Using the SPW (Signal Processing WorkSystem) simulation tool, the performance of the system is evaluated under additive white Gaussian noise, with Rayleigh fading, and with enhancement through coding (notably convolutional encoding and Viterbi decoding) and convolutional interleaving. In the Rayleigh fading simulation, the scintillation effect is introduced into the channel, and the steps used to design the digital filter that introduces this effect are provided. For each simulation, the block diagram of the evaluated system is given as it is used in SPW. Results are compared with theoretical performance and shown graphically. Source file program listings are also included. The main finding is that the simulation results agree with the theoretical and confirm those simulations performed independently by the Raytheon Company, with the exception of soft-decoding phase shift keying, for which both the SPW and Raytheon simulations produce probabilities of error that exceed the theoretical upper bound. CISTI

N93-24041# Oak Ridge National Lab., TN.

IMMUNIZING DIGITAL SYSTEMS AGAINST ELECTROMAGNETIC INTERFERENCE

P. D. Ewing, K. Korsah, and C. Antonescu (Nuclear Regulatory Commission, Washington, DC.) 1993 13 p Presented at the 2nd International Conference on Nnclear Engineering, San Francisco, CA, 21-24 Mar. 1993

(Contract DE-AC05-84OR-21400)

(DE93-005935; CONF-930352-11) Avail: CASI HC A03/MF A01

This paper discusses the development of the technical basis for acceptance criteria applicable to the immunization of digital systems against electromagnetic interference (EMI). The work is sponsored by the US Nuclear Regulatory Commission and stems from the safety-related issues that need to be addressed as a result of the application of digital instrumentation and control systems in nuclear power plants. Designers of digital circuits are incorporating increasingly higher clock frequencies and lower logic level voltages, thereby leading to potentially greater susceptibility of spurious interference being misinterpreted as legitimate logic. Development of the technical basis for acceptance criteria to apply to these digital systems centers around establishing good engineering practices to ensure that sufficient levels of electromagnetic compatibility (EMC) are maintained between the nuclear power plant's electronic and electromechanical systems. First, good EMC design and installation practices are needed to control the emissions from interference sources and thereby their impact on other nearby circuits and systems. Secondly, a test and evaluation program is needed to outline the EMI tests to be performed, the associated test methods to be followed, and adequate test limits to ensure that the circuit or system under test meets the recommended guidelines. Test and evaluation should be followed by periodic maintenance to assess whether the recommended EMI control practices continue to be adhered to as part of the routine operation of the nuclear power plant. By following these steps, the probability of encountering safety-related instrumentation problems associated with EMI will be greatly reduced. DOE

N93-24043# Sandia National Labs., Albuquerque, NM.

ONE-CLASS CLASSIFIER NETWORKS FOR TARGET RECOGNITION APPLICATIONS

M. M. Moya, M. W. Koch, and L. D. Hostetler 1993 5 p

(Contract DE-AC04-76DP-00789)

(DE93-006288; SAND-93-0084C) Avail: CASI HC A01/MF A01

Target recognition requires the ability to distinguish targets from non-targets, a capability called one-class generalization. Many neural network pattern classifiers fail as one-class classifiers because they use open decision

boundaries. To function as one-class classifier, a neural network must have three types of generalization: within-class, between-class, and out-of-class. We discuss these three types of generalization and identify neural network architectures that meet these requirements. We have applied our one-class classifier ideas to the problem of automatic target recognition in synthetic aperture radar. We have compared three neural network algorithms: Carpenter and Grossberg's algorithmic version of the Adaptive Resonance Theory (ART-2A), Kohonen's Learning Vector Quantization (LVQ), and Reilly and Cooper's Restricted Coulomb Energy network (RCE). The ART 2-A neural network gives the best results, with 100 percent within-class, between-class, and out-of-class generalization. Experiments show that the network's performance is sensitive to vigilance and number of training set presentations. DOE

N93-24065# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

SCIENTIFIC VISUALIZATION OF VOLUMETRIC RADAR CROSS SECTION DATA M.S. Thesis

Thomas G. Wojszynski Dec. 1992 69 p

(AD-A259586; AFIT/GCS/Eng/92D-21) Avail: CASI HC A04/MF A01

For aircraft design and mission planning, designers, threat analysts, mission planners, and pilots require a Radar Cross Section (RCS) central tendency with its associated distribution about a specified aspect and its relation to a known threat, Historically, RCS data sets have been statically analyzed to evaluate a d profile. However, Scientific Visualization, the application of computer graphics techniques to produce pictures of complex physical phenomena appears to be a more promising tool to interpret this data. This work describes data reduction techniques and a surface rendering algorithm to construct and display a complex polyhedron from adjacent contours of RCS data. Data reduction is accomplished by sectorizing the data and characterizing the statistical properties of the data. Color, lighting, and orientation cues are added to complete the visualization system. The tool may be useful for synthesis, design, and analysis of complex, low observable air vehicles. GRA

N93-24084# Space Technology Corp., Fort Collins, CO.

REAL-TIME SIGNAL PROCESSING SYSTEMS Final Report, 5 Oct. 1989 - 29 Oct. 1992

Michael Andrews 29 Oct. 1992 374 p

(Contract DAAD07-89-C-0212)

(AD-A259548) Avail: CASI HC A16/MF A03

An Expandable Victor Accelerator (EVA) and its hardware and software capable of processing range and range rate data, digital focus, real-time Kalman filtering, real-time target motion resolution (TMR), and processing image/pattern information for real-time optical trackers of multi-munitions scenes are developed. EVA consists of two major but tightly coupled components, a Vector Processing Hardware (VPH) and a Cascadable Processing Hardware (CPH). VPH is a speed optimized architecture capable of processing vectors of complex data. The architecture is based upon the utilization of multiple Zoran VSP-325 chips. CPH is also a speed optimized. However, the architecture is configured for those applications where the concern for high precision and wide dynamic range is at a premium. CPH hardware utilizes multiple Bipolar Integrated B2110/B2120 and multiple 12x14 CrossBar custom chips. VPH was fabricated, completed and demonstrated successfully as proposed. However, CPH is incomplete with only 70 percent of the design accomplished. The Cross Bar custom chips were fabricated and completed. GRA

N93-24120# Mathematical Technologies, Inc., Providence, RI.

DEVELOPMENT OF LASER RADAR ATR ALGORITHM. PHASE 2: MILITARY OBJECTS

Elie Bienenstock, Donald Geman, Stuart Geman, and Donald E. McClure 31 Oct. 1990 67 p

(Contract DAAL02-89-C-0081)

(AD-A237544) Avail: CASI HC A04/MF A01

Under this contract, MTI has developed a software system for the automatic recognition of military targets occurring in laser radar range data. The algorithm is designed to operate over a variety of scenarios: the targets may occur in multiple numbers and aspects, and may be partially occluded due to other vehicles, irregularities in the terrain, or background clutter. The particular algorithm delivered to CNVEO under this contract is configured to detect and classify three particular targets (M35, M60, and M113), but the system is based on very general principles concerning invariant rigid body object recognition and easily extended to additional targets, clutter types, sensor effects, and degrees of freedom in the viewing angles. In fact, an enhancement and special purpose implementation of a generic object recognition system developed at MTI is represented. Initially, this system was developed for the classification of two-dimensional shapes in highly degraded, visible light intensity data; in particular, optical character recognition served as a convenient and challenging prototype problem, and MTI has now developed a commercially viable software product capable of accurate identification of printed characters in noisy and cluttered images, such as high magnification photographs of alphanumeric identifications on silicon wafers. Author

N93-24133# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

A METHOD FOR SKEW-FREE DISTRIBUTION OF DIGITAL SIGNALS USING MATCHED VARIABLE DELAY LINES

Thomas Knight and Henry Wu Mar. 1992 14 p

(Contract N00014-89-J-3202; NSF MIP-90-01651)

(AD-A260171; AI-M-1282) Avail: CASI HC A03/MF A01

The ability to distribute signals to all parts of a circuit with precisely controlled and known delays is essential in large, high-speed digital systems. We present a technique by which a signal driver can adjust the arrival time of the signal at the end of the wire using a pair of matched variable delay lines. We show how this idea can be implemented requiring no extra wiring, and how it can be extended to distribute signals skew-free to receivers along the signal run as well as the receiving end. We demonstrate how this scheme can be implemented as part of the pad and scan logic of a VLSI chip. GRA

N93-24203 Department of National Defence, Ottawa (Ontario).

LOG-PERIODIC SLOT ANTENNA Patent

Yung L. Chow, inventor (to Department of National Defence) 25 Feb. 1992 24 p Filed 18 Jan. 1988

(CA-Patent-1-296-421; Int-Patent-Class-H01Q-11/10; CTN-93-60641)

Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC

A log periodic slot antenna is comprised of an array of log periodically spaced, parallel radiating slots of increasing length, and a plurality of coplanar guides, each line connecting one pair of adjacent slots. The coplanar guides are arranged alternately on opposite sides of the center line of the antenna, the connection point with each slot being spaced from the adjacent slot edge by a distance approximately one quarter of the slot length. In a modified version of this antenna, the dimension of the ground plane is of the same order of magnitude as the dimensions of the array whereby the antenna pattern has a null in the forward direction in the plane of the ground plane. In a further modification, two such log periodic slot antennas are arranged with a common vertex and with their ground planes coplanar. An in-phase feed connection for each antenna is arranged such that the cross polarization antenna pattern in the plane of the antenna has a null in the forward direction. This antenna is useful for accurate direction finding. Author (CISTI)

N93-24232# Department of the Navy, Washington, DC.

METHOD AND APPARATUS FOR DETERMINING TARGET ELEVATION ANGLE, ALTITUDE AND RANGE, AND THE LIKE IN A MONOPULSE RADAR SYSTEM WITH REDUCED MULTIPATH ERRORS Patent Application

Dean D. Howard, inventor (to Navy) 29 May 1992 30 p

(AD-D015622; US-Patent-Appl-SN-889806; Navy-Case-70889) Avail: CASI HC A03/MF A01

The present invention relates to a method and system for determining target elevation angle, altitude and range and the like in a monopulse radar system with reduced multipath errors. A transmitter/receiver unit receives monopulse sum and difference signals caused by echoes from targets. The sum and difference signals are then logarithmically-amplified in a logarithmic amplifier unit. A selector selects one of the sum and difference signals having the largest amplitude, and generates a selection signal indicating which of the sum and difference signals has the largest amplitude. The selection signal is provided to a search radar target tracking unit which determines whether a target at a given range interval and

azimuth interval, for example, has been selected for tracking by an operator. The search radar target tracking unit then controls a gate unit to selectively provide either the logarithmically-amplified sum signal or the logarithmically-amplified difference signal to a peak detection unit based on the selection signal, and based on whether a particular target has been selected for tracking. GRA

N93-24243# Environmental Research Inst. of Michigan, Ann Arbor.
SAXON-FPN NAWC/ERIM P-3 SAR DATA DISTRIBUTION AND ANALYSIS Final Report, Oct. 1991 - Sep. 1992
Christopher C. Wackerman 1 Nov. 1992 64 p
(Contract N00014-91-C-0207)
(AD-A259944; ERIM-240600-4-F) Avail: CASI HC A04/MF A01

As part of the SAXON-FPN Experiment, ERIM collected, processed and distributed SAR imagery from the ERIM/NAWC P-3 system. In addition we analyzed data collected in a spotlight mode to extract estimates of the real modulation transfer function. The report summarizes both activities, along with an analysis of the cross-channel coupling for cross-polarized data for the system. GRA

N93-24277# Optech, Inc., Santa Ana, CA.
NOVEL OPTICAL PROCESSOR FOR PHASED ARRAY ANTENNA Final Report, 1 Mar. - 1 Sep. 1992
Shi-Kay Yao 20 Oct. 1992 54 p
(Contract DAAL03-92-C-0009)
(AD-A260474; ARO-29477.1-EL-SBI) Avail: CASI HC A04/MF A01

Investigations are conducted on two optical devices, namely a fiber-optic phase conjugation loop for cancellation of phase jitter noise in RF distribution network and an acousto-optic imaging spatial light modulator. Analytical as well as experimental studies were performed on several critical technical issues with success. Developmental issues and phase 2 program were outlined for further development towards experimental demonstration of the proposed technologies and systems. GRA

N93-24318# Hughes Aircraft Co., Fullerton, CA. Ground Systems Group.
STEP STRESS TESTING OF RECEIVER/TRANSMITTER UNITS, PART 1 Final Report, Jul. 1991 - Jun. 1992
Steve Burnett, David Huch, Larry James, Stephen Mueller, and Peggy Tran
Feb. 1993 175 p
(Contract F30602-89-D-0100)
(AD-A260182; RL-TR-93-21-Pt-1) Avail: CASI HC A08/MF A01

This report has been prepared to summarize a test validation effort for an accelerated life testing model which uses a wide parametric Bayesian Analysis Methodology. Step stress testing was performed on seven Joint Tactical Information Distribution System (JTIDS) Class 1 synthesizer detector, radio frequency assemblies. Failure-data and analyses are provided. The report addresses issues concerning how to demonstrate high reliability (Mean-Time-Between-Failure values of 10,000 hours or more) on procured Air Force systems without incurring excessive testing costs. GRA

N93-24459# Phillips Lab., Kirtland AFB, NM.
A FIGURE OF MERIT FOR TRANSIT-TIME-LIMITED TIME-DERIVATIVE ELECTROMAGNETIC FIELD SENSORS Technical Note
Carl E. Baum Jan. 1993 26 p
(AF Proj. 9993)
(AD-A260016; PL-TN-92-1016) Avail: CASI HC A03/MF A01

This note derives a sensitivity-bandwidth figure of merit for comparing the performance of sensors designed to measure the time derivative of D or B. This figure of merit is a dimensionless number combining sensitivity and upper frequency response (bandwidth) in a form equivalent area times the square of bandwidth. The larger the figure of merit A, the more efficient is the design. This figure of merit is appropriate where sensor size is not a factor, but sensitivity and bandwidth are of primary concern. GRA

N93-24460# Phillips Lab., Kirtland AFB, NM.
THE SINGLE-GAP HOLLOW SPHERICAL DIPOLE IN NON-CONDUCTING MEDIA Technical Note
Carl E. Baum Jan. 1993 72 p
(AF Proj. 9993)
(AD-A260017; PL-TN-92-1019) Avail: CASI HC A04/MF A01

This note considers the response of a hollow spherical dipole in non-conducting media. This sensor is a sphere with a slot around the equator which is uniformly resistively loaded. The current through the resistive load across the slot is proportional to the time rate of change of the displacement vector for low frequencies. The response characteristics of such a device at high frequencies are calculated using expansions in spherical wave functions. These calculations include the dependence of the sensor response on both frequency and the direction of wave incidence. GRA

N93-24466# Pacific Northwest Lab., Richland, WA.
THE PROCESS OF CONSENSUS ON EMF: SAB REVIEW OF THE EPA DRAFT DOCUMENT ON EMF AND CANCER
B. W. Wilson Jun. 1992 12 p Presented at the Annual Meeting of the Air and Waste Management Association (AWMA), Kansas City, MO, 21-26 Jun. 1992
(Contract DE-AC06-76RL-01830)
(DE93-007183; PNL-SA-21034; CONF-9206114-19) Avail: CASI HC A03/MF A01

The EPA Draft Document on EMF and Cancers grew out of an earlier effort by EPA to track biological effects literature relative to radio-frequency (RF) exposure. Scope of the document was broadened to include extremely low frequency electric and magnetic fields prior to an announcement in 1986 that EPA would formally review the whole area of non-ionizing radiation. An extensive survey of the relevant bioeffects and epidemiologic literature was carried out, and writing on the document began in earnest on the document sometime in 1989. In its draft form, the document reviewed the literature on mechanisms of Interaction between electromagnetic fields and biological tissue, EMF epidemiologic studies, supporting evidence for carcinogenicity and research needs. In the early summer of 1990, a draft of the document was reviewed by some 22 individuals within the EPA and other government agencies. It was also sent out for external review to an additional 9 qualified scientists who had worked in the area and were familiar with EMF-related literature in epidemiology, biology, and physics. Many of the comments sent to EPA from this first review, prior to release of the draft for public comment, were strikingly similar to those resulting from the second (public) review process. Thus, it appears that much of the controversy that was later associated with the document could have been avoided had the authors been diligent in following the recommendations of the initial set of reviewers. DOE

N93-24471*# Arizona State Univ., Tempe. Coll. of Engineering and Applied Science.
ANTENNA PATTERN CONTROL USING IMPEDANCE SURFACES Semiannual Progress Report, 16 Sep. 1992 - 15 Mar. 1993
Constantine A. Balanis and Kefeng Liu 15 Mar. 1993 28 p
(Grant NAG1-1183)
(NASA-CR-192712; NAS 1.26:192712; TRC-EM-CAB-93003) Avail: CASI HC A03/MF A01

A hybrid numerical technique is developed for electrically large pyramidal horn antennas radiating in free space. A stepped-waveguide method is used to analyze the interior surfaces of the horn transition. The Electric Field Integral Equation (EFIE) is employed on the outer surfaces of the pyramidal horn including the radiating aperture. Meanwhile, the Magnetic Field Integral Equation (MFIE) is used on the aperture to relate the aperture fields and those in the horn transition. The resultant hybrid field integral equation (HFIE) is solved numerically by the method of moments. This formulation is both accurate and numerically stable so that high-gain microwave pyramidal horns can be analyzed rigorously. Far-field radiation patterns, both computed and measured, are presented for three electrically-large x-band horn antennas. The comparisons demonstrate that this method is accurate enough to predict the fine pattern structure at wide angles and in the back region. Computed far-field patterns and aperture field distribution of two smaller x-band horns are also presented along with a discussion on the validity of the approximate aperture field distributions routinely used in the analysis and design of pyramidal horns. Author

N93-24563# Defence Research Establishment, Ottawa (Ontario).
SUPPRESSION OF POWER LINE HARMONIC INTERFERENCE IN HF SURFACE-WAVE RADAR Technical Report
Hank Leong Oct. 1992 31 p
(AD-A259917; DREO-1137) Avail: CASI HC A03/MF A01

Experimental data of the Cape Bonavista High-Frequency Surface-Wave

Radar (HFSWR) Facility was contaminated by power line harmonics. The harmonics modulate the radar signal (mainly sea clutter) and replicate it into the Doppler spectrum. The spectral replicas distort the noise and sea clutter statistics in the signal. It is necessary to suppress them before the statistics can be obtained. A new process based on optimizations is presented for suppressing the interference. This process minimizes the spectral power of the sea clutter with respect to the amplitudes and phases of the harmonics. It is capable of removing the spectral replicas without adversely altering the statistics. This process, however, requires adequate modeling of the harmonics. A large number of parameters are required because the harmonics may have a fluctuating fundamental frequency and fluctuating amplitudes. Therefore, the process can be numerically complex. To implement our process, one must use approximations in the signal model. If the amplitudes and the fundamental frequency are approximated with constants, the process can still be effective for a short HFSWR data series. For some 256-point data series, more than 20 dB of the peak interference can be reduced. For a long HFSWR data series, the same process can be applied by first dividing it into several short data segments, and then optimizing on the individual segments. With this slightly revised approach, up to 20 dB of the peak interference can be suppressed for a long data series. GRA

N93-24618 Carleton Univ., Ottawa (Ontario). Dept. of Systems and Computer Engineering.

A LOW-DELAY BACKWARD-ADAPTIVE CELP SPEECH CODER M.S. Thesis

Leonardo G. Neumeyer Ottawa, Ontario Carleton Univ. Aug. 1990 110 p

(ISBN-0-315-60461-1; CTN-93-60655) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, J8X 3X2, Canada, HC

The latest techniques used in code-excited linear prediction (CELP) coders are examined in order to simulate a complete design of a digital coding system for voice communication applications. The focus of the research is on investigating the feasibility of modifying the conventional CELP structure to achieve shorter encoding delays. Different aspects of a CELP coder design at bit rates of 8 Kb/s are investigated and a complete design procedure is presented. A modification of the original CELP configuration is introduced which reduces the encoding delay by 80 percent by using a backward adaptive short-term predictor. To control filter tracking, a novel mixed distortion measure is proposed. This distortion mixes noise-weighted mean squared error with the log-likelihood distortion measure. Formal listening tests, based on mean opinion score measure, have shown that speech quality in the proposed and conventional coders are very similar. Author (CISTI)

N93-24619# European Space Agency, Paris (France).

SCATTERING CENTRE ANALYSIS OF SIMPLE METALLIC OBJECTS

Ulrich Fuchs (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany.) Sep. 1992 209 p Transl. into ENGLISH of Streuzentrenanalyse in derMikrovellenabbildung einfacher metallischer Streukoerper Original language document was announced as N91-16216 (ESA-TT-1250; DLR-FB-90-32; ETN-93-93516) Avail: CASI HC A10/MF A03; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Measurements of the complex signal backscattered by metallic cubes, plates, cylinders, and combinations of these objects, are reported. The measurements are employed to generate microwave images which typically exhibit only a few intensity maxima, so called scattering centers. Methods for analyzing the dependence of the corresponding scattering mechanisms in frequency, aspect angle and polarization, are developed. Interpretations of the experimental results are compared with model calculations on the basis of the geometrical theory of diffraction. ESA

N93-24620 Toronto Univ. (Ontario). Dept. of Electrical Engineering.

OPTIMUM SPACE-TIME PROCESSING IN NON-STATIONARY ENVIRONMENTS Ph.D. Thesis

Benoit Champagne Toronto, Ontario Univ. of Toronto 1990 165 p

(ISBN-0-315-56985-9; CTN-93-60656) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

A structural analysis is made of the LLP (space-time log-likelihood processor) that applies to arbitrary signal transmission models comprising N sources, M sensors, a time varying linear channel, and non-stationary Gaussian signal and noise processes. The main results are factorization properties satisfied by the solutions of the classical M-dimensional integral equations defining the LLP. As a consequence of these properties, the LLP can be decomposed in a cascade of three specialized sub-processors. In one application of these structural results, a solution to the problem of exact maximum likelihood (EML) time delay estimation for short observation intervals is obtained. The resulting EML instrumentation consists of a delay-and-sum beamformer followed by a post-processor. Computer simulations show that EML can lead to significant improvement in performance compared to the conventional maximum likelihood estimator. In a second application, the general problem of source parameter estimation for multiple sources monitored through a slowly varying linear channel is solved by introducing a new class of slowly varying linear systems. Closed form expressions are obtained for the LLP and the lower bound on estimator variance. These general results are applied to the problem of time-varying delay estimation in the presence of directional interference.

Author (CISTI)

N93-24626 Concordia Univ., Montreal (Quebec). Dept. of Electrical and Computer Engineering.

VERSATILE REED-SOLOMON DECODERS Ph.D. Thesis

Yousef Rajableh-Shayan Montreal, Quebec Concordia Univ. Aug. 1990 173 p

(ISBN-0-315-64738-8; CTN-93-60644) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

Reed-Solomon (RS) codes have found many applications such as space and mobile communication due to their error correcting capability (ECC) and optimum structure. It is shown that time domain algorithms are the best candidates for designing versatile hardware decoders, but syndrome based algorithms are advantageous for software decoders. The algorithms for decoding RS codes require algebraic operations over Galois fields. Parallel in, parallel out multipliers and inverters in Galois fields are considered and least complex structures for the multiplier are introduced. A new normal basis multiplier is presented, as well as a universal multiplier for multiplying two elements of Galois field 2 to the m (m=4,5,6,7,8). The time domain algorithm based on transform decoder is restructured and two versatile decoder structures are presented. Both are simple and modular, thus suitable for very large scale integration design, and can be used for decoding any primitive RS code defined in a specific Galois field. The ECC of these decoders is configurable. The structure of a universal RS decoder is also presented. The time domain decoding algorithm based on algebraic decoder is modified to reduce the complexity of the universal decoder. The ECC and the size for the Galois field of this decoder are configurable. A method is also introduced for decoding RS codes generated by any generator polynomial. Author (CISTI)

N93-24627 Carleton Univ., Ottawa (Ontario). Dept. of Systems and Computer Engineering.

SIMULATION OF A NC-FSK MAXIMUM LIKELIHOOD RECEIVER FOR FAST RAYLEIGH FADING M.S. Thesis

Robin D. Addison Ottawa, Ontario Carleton Univ. 21 Dec. 1989 123 p

(ISBN-0-315-59024-6; CTN-93-60649) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

The theory for detection of noncoherent frequency shift keying (NC-FSK) transmitted over a Rayleigh fading channel, such as in mobile and satellite communications, is introduced. Both conventional noncoherent detection and the maximum likelihood detection scheme are described. As an example of the latter, a Gaussian detector is introduced and developed into a general Gaussian receiver and then into the linear predictive receiver (LPR). These maximum likelihood detectors are compared for complexity versus performance and are examined in the two extremes of very slow and very fast fading. Simulation results are provided which characterize the conventional NC-FSK and the LPR. Binary FSK results are presented for various signal to noise ratios and fading bandwidths. These are compared to the analytical results and to those of conventional NC-FSK. M-ary FSM results are then presented. The sensitivity of the receiver to channel

parameter estimation errors was investigated by simulation and the results are shown for errors in fading bandwidth and signal to noise estimates. Simulation results for a reduced complexity version of the LPR are also presented. The effects of different channel models on simulation results are examined and the LPR performance in fast fading is compared to that of conventional diversity schemes in slow fading conditions.

Author (CISTI)

N93-22019# Naval Air Warfare Center, China Lake, CA. Weapons Div.
ELECTROMAGNETIC RADIATING SOURCE ELIMINATION (ERASE) PROGRAM
Don R. Stapleton, George W. Hoppus, and Robert E. Sutton *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 4 p (For primary document see N93-22018 08-31)
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N93-22024# Bilkent Univ., Ankara (Turkey).
MULTIVARIABLE FREQUENCY RESPONSE METHODS FOR OPTIMAL KALMAN-BUCY FILTERS WITH APPLICATIONS TO RADAR TRACKING SYSTEMS
C. C. Arcasoy *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 14 p (For primary document see N93-22018 08-31)
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N93-22030# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).
RADAR SEEKER BASED AUTONOMOUS NAVIGATION UPDATE SYSTEM USING TOPOGRAPHY FEATURE MATCHING TECHNIQUES
H. D. Lerche and F. Tumbreagel *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 13 p (For primary document see N93-22018 08-31)
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N93-22173*# Idaho National Engineering Lab., Idaho Falls.
VIDEO CONFERENCING MADE EASY
D. Gail Larsen and Paul R. Schwieder *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 235-241 (For primary document see N93-22149 08-99)
(Contract DE-AC07-76ID-01570)
Avail: CASI HC A02/MF A04

N93-22177*# Wilton Industries, Inc., Ridgefield, CT.
WIRELESS INFRARED COMMUNICATIONS FOR SPACE AND TERRESTRIAL APPLICATIONS
James W. Crimmins *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 277-280 (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

N93-22283*# Motorola, Inc., Chandler, AZ. Strategic Electronics Div.
RENDEZVOUS RADAR FOR THE ORBITAL MANEUVERING VEHICLE
Abstract Only
John W. Locke, Keith Olds, and Howard Parks *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22567*# Ohio Univ., Athens.
A HYBRID VOICE/DATA MODULATION FOR THE VHF AERONAUTICAL CHANNELS
Dennis M. Akos *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1991-1992 Feb. 1993 p 53-65 (For primary document see N93-22561 08-01)
Avail: CASI HC A03/MF A02

N93-23508# Federal Maritime and Hydrographic Agency (Germany).
MARITIME SATELLITE COMMUNICATION AND NAVIGATION
Peter Ehlers *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 5-8 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23514# Lufthansa German Airlines, Frankfurt (Germany).
AIRLINE APPLICATIONS IN AIR-/GROUND COMMUNICATION USING ADVANCED TECHNOLOGIES
Heinrich Mensen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 37-38 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23515# Telesat Canada, Ottawa (Ontario).
THE CANADIAN MOBILE SATELLITE SYSTEM
Elemer Bertenyi *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 39-43 (For primary document see N93-23507 08-43)
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N93-23516# Rhode and Schwartz G.m.b.H., Munich (Germany).
FULLY AUTOMATIC TRANSMISSION OF INFORMATION VIA HF AND COMPARISON TO SATELLITE TRANSMISSION
P. Iselt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 45-50 (For primary document see N93-23507 08-43)
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N93-23517# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Communications Technology Inst.
LAND MOBILE SATELLITE COMMUNICATIONS SYSTEMS AND SERVICES
E. Lutz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 51-55 (For primary document see N93-23507 08-43)
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N93-23518# Air Navigation Technical Service, Paris (France).
THE FUTURE ROLE OF SATELLITE COMMUNICATIONS IN AN IMPROVED AIR TRAFFIC MANAGEMENT
Patrice Gauthier (Service Technique de la Navigation Aerienne, Paris, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 57-60 (For primary document see N93-23507 08-43)
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N93-23520# International Maritime Satellite Organization, London (England).
MOBILE SATELLITE COMMUNICATIONS IN THE 1990'S
Jai Singh *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 69-73 (For primary document see N93-23507 08-43)
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N93-23521# Italspazio, Rome (Italy).
PERSONAL COMMUNICATIONS SATELLITE SERVICE SYSTEM
L. Caporicci, S. DiGirolamo, M. Luongo, and C. Soddu *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 75-80 (For primary document

see N93-23507 08-43)
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N93-23525# Centre d'Etudes de la Navigation Aerienne, Toulouse (France).
OSI APPLIED TO AERONAUTICAL SATELLITE MOBILE COMMUNICATIONS IN EURATN
Franck Monteil *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 97-102 (For primary document see N93-23507 08-43)
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N93-23526# Eutelsat, Paris (France).
EUTELTRACS: THE EUROPEAN LAND MOBILE SATELLITE SERVICE
Jean-Noel Colcy, Rafael Steinhaeuser, and Kimberly Mock (Alcatel Qualcomm, Nanterre, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 103-108 (For primary document see N93-23507 08-43)
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N93-23527# ANT Nachrichtentechnik, Backnang (Germany).
GLOBAL EARTH OBSERVATION USING MODERN COMMUNICATIONS SATELLITE TECHNIQUES
E. Loecherbach and G. Eckhardt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 111-116 (For primary document see N93-23507 08-43)
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N93-23530# Kayser Threde G.m.b.H., Munich (Germany).
COMLINE
N. Balteas *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 127-131 (For primary document see N93-23507 08-43)
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N93-23531# DMT Martinetetechnik G.m.b.H., Hamburg (Germany).
FLEET MANAGEMENT BASED ON SATELLITE POSITIONING AND COMMUNICATION
Bernd Hossfeld *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 133-134 (For primary document see N93-23507 08-43)
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N93-23543# Bell Telephone Mfg. Co., Antwerp (Belgium).
COMMUNICATIONS TECHNIQUES SUPPORTING THE DATA MANAGEMENT
P. Dosiere *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 203-207 (For primary document see N93-23507 08-43)
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N93-23810# EFTAS Fernerkundung Technologietransfer, Muenster (Germany).
THE MARINFOSEC STUDY: USE OF ERS-1 FOR CRUISE AND SAILING BOATS
K.-U. Komp *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects . 1992 p 1277-1278 (For primary document see N93-23748 08-43)
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N93-24356# Joanneum Research Centre, Graz (Austria). Applied Systems Technology Inst.
VIDEOMIR: SATELLITE VIDEO CONFERENCING DURING THE AUSTROMIR SPACEFLIGHT
O. Koudelka and W. Riedler (Technische Univ., Graz, Austria.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth ' Orbiting Laboratories Jul. 1992 p 105-110 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)
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33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N93-22054# Purdue Univ., West Lafayette, IN.
MIDWEST SUPERCONDUCTIVITY CONSORTIUM
A. L. Bement, Jr. Jan. 1993 65 p
(Contract DE-FG02-90ER-45427)
(DE93-006146; DOE/ER-45427/3) Avail: CASI HC A04/MF A01

The mission of the Midwest Superconductivity Consortium, MISCON, is to advance the science and understanding of high Tc superconductivity. Programmatic research focuses upon key materials-related problems; principally, synthesis and processing and properties limiting transport phenomena. During the past year, 26 projects produced over 133 talks and 113 publications. Two Master's Degrees and one Ph.D. were granted to students working on MISCON projects. Group activities and interactions involved two MISCON group meetings (held in July and January), twenty external speakers, 36 collaborations, 10 exchanges of samples and/or measurements, and one (1) gift of equipment from industry. Research achievements this past year expanded our understanding of processing phenomena on structure property interrelationships and the fundamental nature of transport properties in high-temperature superconductors. DOE

N93-22322# Los Alamos National Lab., NM.
DESIGN AND CHARACTERIZATION OF THE PEGASUS 1 PLASMA FLOW SWITCH
F. J. Wysocki, R. R. Bartsch, R. L. Bowers, J. C. Cochrane, A. E. Greene, J. S. Ladish, P. H. Y. Lee, J. V. Parker, D. L. Peterson, and J. F. Benage et al 1992 8 p Presented at the 6th International Conference on Megagauss Magnetic Field Generation and Related Topics, Albuquerque, NM, 9-12 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003812; LA-UR-92-3649; CONF-921133-6) Avail: CASI HC A02/MF A01

A plasma flow switch (PFS) based on an experimental design utilized at the Air Force Weapons Laboratory (AFWL) was fielded on the Pegasus I system. Currents of as much as 5.8 MA were switched on a time scale (10-90 percent) of 200 ns into a static load. Tests with a foil load resulted in a less than ideal current transfer because of interaction between the dynamic load and the plasma flow switch. Two-dimensional radiation magnetohydrodynamic (RMHD) calculations were used to characterize the behavior of the PFS and to aid in the design. These calculations were also used to investigate several classes of perturbations in the switch-plasma, the interaction of the switch-plasma with the coaxial electrodes, and their effect on switching efficiency. The Pegasus I PFS experiments reproduce the results obtained at AFWL throughout the switch initiation and switching

phases. However, early in the foil implosion the switched current drops significantly. We believe this current drop results from a small amount of residual plasma left behind in the PFS region that impedes the magnetic-flux transport, thereby preventing efficient foil implosion. The experimental results suggest that the method of PFS initiation (viz. chordal wire arrays) may be an important factor in switch operation. DOE

N93-22425# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.

A HIGH-POWER 95 GHz GYRO-TWT AMPLIFIER

K. E. Kreischer, M. Basten, M. Blank, B. G. Danly, W. C. Guss, and R. J. Temkin Jul. 1992 55 p

(Contract DE-AC02-78ET-51013)

(DE93-002332; PFC/RR-92-11) Avail: CASI HC A04/MF A01

The need for radar systems with greater resolution has led to renewed interest in the development of efficient high-power amplifiers at 95 GHz. The gyro-TWT is capable of producing high power with the added attraction of having lower ohmic loading on the smooth fast-wave interaction circuit than conventional slow-wave sources. We have completed a comprehensive design of a 95 GHz gyro-TWT amplifier that is capable of producing 120 kW of output power with an efficiency of 30 percent. a saturated gain of 38 dB, and an instantaneous bandwidth of over 5 GHz. Our concept uses an annular beam produced by a MIG electron source and operates in the TE(sub 5,1) cylindrical waveguide mode. Realistic beam parameters from gun simulations were, included in our efficiency calculations. In addition, our design includes the use of a compact superconducting magnet, quasi-optical input and output couplers and a sever to suppress oscillations. The overall mechanical design shows that a compact, lightweight amplifier with adequate beam clearance is possible. This report also includes a study of a gyro-TWT using a solid on-axis beam from a Pierce-wiggler electron source coupling with a TE(sub 1,eta) waveguide mode. Nonlinear models indicated that an efficient interaction with the waveguide mode was possible, however, beam simulations indicated that the high current density beam had large internal space charge forces that caused a substantial degradation of the beam quality. DOE

N93-22451 National Physical Lab., Teddington (England). Electrical Science Div.

TRACEABILITY FOR RADIO FREQUENCY COAXIAL LINE STANDARDS

J. P. Ide Jul. 1992 62 p

(NPL-DES-114; ETN-93-93546) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A study on the traceability of air gauging is presented. Air gauging is a technique for determining the physical dimensions of an item by using the flow rate of air as a measure of the gap between the measurement head and the item. It allows fast and accurate measurement of the internal or external dimensions of items without physical contact. The techniques and the factors that determine the theoretical limits to the accuracy of this method are examined. A practical air gauging system is described and the uncertainties ensuing from using such a system to provide traceability for the national standards of impedance for RF and microwave coaxial items are examined. Calibration and measurement procedures to ensure that the integrity of the measurements is maintained are concluded. ESA

N93-22479*# Case Western Reserve Univ., Cleveland, OH.

AN EXPERIMENTAL INVESTIGATION OF HIGH TEMPERATURE SUPERCONDUCTING MICROSTRIP ANTENNAS AT K- AND Ka-BAND FREQUENCIES Ph.D. Thesis Final Report

Mark A. Richard Mar. 1993 241 p

(Contract NCC3-99; RTOP 506-72-1B)

(NASA-CR-191089; E-7645; NAS 1.26:191089) Avail: CASI HC A11/MF A03

The recent discovery of high temperature superconductors (HTS) has generated a substantial amount of interest in microstrip antenna applications. However, the high permittivity of substrates compatible with HTS results in narrow bandwidths and high patch edge impedances of such antennas. To investigate the performance of superconducting microstrip antennas, three antenna architectures at K and Ka-band frequencies are examined. Superconducting microstrip antennas that are directly coupled, gap coupled, and electromagnetically coupled to a microstrip transmission line were designed and fabricated on lanthanum aluminate substrates using YBa2Cu3O7 superconducting thin films. For each architecture, a single patch antenna and a four element array were fabricated. Measurements from these antennas, including input impedance, bandwidth, patterns, efficiency, and gain are presented. The measured results show usable antennas can be constructed using any of the architectures. All architectures show excellent gain characteristics, with less than 2 dB of total loss in the four element arrays. Although the direct and gap coupled antennas are the simplest antennas to design and fabricate, they suffer from narrow bandwidths. The electromagnetically coupled antenna, on the other hand, allows the flexibility of using a low permittivity substrate for the patch radiator, while using HTS for the feed network, thus increasing the bandwidth while effectively utilizing the low loss properties of HTS. Each antenna investigated in this research is the first of its kind reported.

Author (revised)

N93-22485*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.

SPACE POWER AMPLIFICATION WITH ACTIVE LINEARLY TAPERED SLOT ANTENNA ARRAY

Rainee N. Simons and Richard Q. Lee (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Cleveland, OH Jun. 1993 6 p Prepared for presentation at the International Microwave Symposium-MTT '93, Atlanta, GA, 14-18 Jun. 1993; sponsored by the IEEE

(RTOP 506-44-2C)

(NASA-TM-106036; E-7604; NAS 1.15:106036) Avail: CASI HC A02/MF A01

A space power amplifier composed of active linearly tapered slot antennas (LTSA's) has been demonstrated and shown to have a gain of 30 dB at 20 GHz. In each of the antenna elements, a GaAs monolithic microwave integrated circuit (MMIC) three-stage power amplifier is integrated with two LTSA's. The LTSA and the MMIC power amplifier has a gain of 11 dB and power added efficiency of 14 percent respectively. The design is suitable for constructing a large array using monolithic integration techniques. Author

N93-22511# Superconducting Super Collider Lab., Dallas, TX.

LOW-VOLTAGE-SWING CMOS TRANSCEIVERS

G. Vanstraelen and J. Dorenbosch Dec. 1992 13 p

(Contract DE-AC35-89ER-40486)

(DE93-006607; SSCL-608) Avail: CASI HC A03/MF A01

This report gives a brief overview of two new transceiver techniques. The emphasis is on low power dissipation and low noise. Because commonly used techniques such as Emitter Coupled Logic (ECL) and Back Plane Transceiver Logic (BTL) are known to have a high power dissipation, they are not discussed in this article. Instead, two new techniques, named Gunning Transceiver Logic (GTL) and Double Domino Transceiver Logic (D(exp 2)TL) will be discussed in detail. DOE

N93-22524# Allied-Signal Aerospace Co., Kansas City, MO.

PRINTED WIRING ASSEMBLY CLEANLINESS

J. M. Stephens Dec. 1992 22 p

(Contract DE-AC04-76DP-00613)

(DE93-006040; KCP-613-4825) Avail: CASI HC A03/MF A01

This work installed a product cleanliness test capability in a manufacturing environment. A previously purchased testing device was modified extensively and installed in a production department. The device, the testing process, and some soldering and cleaning variables were characterized to establish their relationship to the device output. The characterization provided information which will be required for cleanliness testing to be an adequate process control of printed wiring assembly soldering and cleaning processes. DOE

N93-22540# Los Alamos National Lab., NM.

DE HAAS VAN ALPHEN EFFECT IN SUPERCONDUCTORS IN MEGAGAUSS FIELDS

C. M. Fowler, B. L. Freeman, W. L. Hults, J. C. King, F. M. Mueller, and J. L. Smith 1992 10 p Presented at the 6th International Conference on Megagauss Magnetic Field Generation and Related Topics, Albuquerque, NM, 9-12 Nov. 1992

(Contract W-7405-eng-36)

(DE93-005465; LA-UR-92-4351; CONF-921133-14) Avail: CASI HC A02/MF A01

The de Haas van Alphen effect was investigated in YBCO recently by Fowler et al. using 100 Tesla fields and temperatures below 4.2 Kelvin. It is concluded that even at these fields these measurements were taken below the superconducting critical field, Bc2. Mixed state quantal oscillatory phonmena have been seen by Graebner and Robins in NbSe2 in 1976 and more recently by Mueller, Lowndes, and Arko et al. in V3Si in lower fields. The implication of such mixed state experiments is discussed. DOE

N93-22577# Brookhaven National Lab., Upton, NY.
JFET MONOLITHIC PREAMPLIFIER WITH OUTSTANDING NOISE BEHAVIOUR AND RADIATION HARDNESS CHARACTERISTICS
V. Radeka, S. Rescia, P. F. Manfredi (Pavia Univ., Italy.), V. Speziali (Pavia Univ., Italy.), and F. Svelto (Pavia Univ., Italy.) Oct. 1992 7 p Presented at the Institute of Electrical and Electronic Engineers (IEEE) Nuclear Science Symposium, Orlando, FL, 26-31 Oct. 1992
(Contract DE-AC02-76CH-00016)
(DE93-006679; BNL-48355; CONF-921005-23) Avail: CASI HC A02/MF A01

A second series of monolithic preamplifiers based on epitaxial channel JFET's and intended for calorimetry at hadron colliders has been realized. The employed buried layer process has been upgraded, resulting in a lower pinch-off voltage and a reduced power dissipation. Results will be presented on noise, dynamic behavior and radiation damage. New versions of the preamplifier have been designed for both large capacitance detectors and for low capacitance pre-shower detectors. DOE

N93-22594# Sandia National Labs., Albuquerque, NM.
UTILITY BATTERY STORAGE SYSTEMS PROGRAM REPORT FOR FY 1992
P. C. Butler Jan. 1993 115 p
(Contract DE-AC04-76DP-00789)
(DE93-006459; SAND-92-2272) Avail: CASI HC A06/MF A02

This report documents the fiscal year 1992 activities of the, Utility Battery Storage Systems Program (UBS) of the US Department of Energy (DOE), Office of Energy Management (OEM). The UBS program is conducted by Sandia National Laboratories (SNL). UBS is responsible for the engineering development of integrated battery systems for use in utility-energy-storage (UES) and other stationary applications. Development is accomplished primarily through cost-shared contracts with industrial organizations. An important part of the development process is the identification, analysis, and characterization of attractive UES applications. UBS is organized into five projects: Utility Battery Systems Analyses; Battery Systems Engineering; Zinc/Bromine; Sodium/Sulfur; Supplemental Evaluations and Field Tests. The results of the Utility Systems Analyses are used to identify several utility-based applications for which battery storage can effectively solve existing problems. The results will also specify the engineering requirements for widespread applications and motivate and define needed field evaluations of full-size battery systems. DOE

N93-22661# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.
A SOLENOID WITH A LOW INPUT POWER AND A FAST SWITCHING TIME [EIN ELEKTROMAGNET MIT GERINGEM LEISTUNGSBEDARF UND KURZER SCHALTZEIT]
Guenther Au Oct. 1991 90 p In GERMAN
(DLR-FB-91-39; ETN-93-91928) Avail: CASI HC A05/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A solenoid was investigated experimentally, and the results were compared with those from theoretical investigations. Besides mechanical construction of the solenoid, the coil must be given great importance. Number of turns, ohmic resistance, self inductivity, and applied DC voltage must be chosen in such an order of magnitude that the other parameters like overall current and voltage drop at the coil will result in a saturation induction, which is compatible with the B, and H characteristics of magnetic materials. Since relatively simple construction is the final goal, industrial serial production will have no problems combined with relatively low costs. ESA

N93-22679# Technische Univ., Berlin (Germany). Fachbereich Ekektrotechnik.
UTILIZATION CRITERIA OF RAPID DISCONNECTABLE POWER SEMICONDUCTORS IN QUASI RESONANT INVERTERS Ph.D. Thesis [EINSATZKRITERIEN SCHNELLER ABSCHALTBARER LEISTUNGSHALBLEITER IN QUASIRESONANZ-UMRICHTERN]
Christian Keller 1991 148 p In GERMAN
(ETN-93-93421) Avail: CASI HC A07/MF A02

The utilization conditions and the behavior of Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and Isolated Gate Bipolar Transistor (IGBT) power semiconductors are examined in quasi-resonant applications. The various concepts of resonant inverter circuits are explained. The examinations of disconnectable advantages over MOSFET are described. A thermal power measuring process is designed, which allows determination of the mean dissipation with a lower measuring uncertainty than when using an oscilloscope. Examinations show that a distinct unloading can be reached for the currently available punch through IGBT of the second generation, by zero current resonance wiring, allowing a decrease in the circuit loss energy by 20 percent with regard to conventional switch operation. ESA

N93-22681# Technische Univ., Berlin (Germany). Fachbereich Elektrotechnik.
CURRENT DISPLACEMENT IN PARABOLIC CYLINDER Ph.D. Thesis [STROMVERDRAENGUNG IM PARABOLISCHEN ZYLINDER]
Gerard Birenbaum 1992 131 p In GERMAN
(ETN-93-93423) Avail: CASI HC A07/MF A02

The eddy current distribution in a conducting parabolic cylinder is determined by two different analytical processes, according to which the source free, z directed vector potential is split up into two independent boundary value problems of the stationary skin effect. In the first analytical processs, a perfectly conductive screen is introduced, which forces Fourier series in the orthogonal direction with still unknown complex coefficients. In the second analytical process, the screen is abandoned, and the potentials in nonconductive space are represented by Fourier integrals. The distribution of eddy currents in the parabolic cylinder at determined times and various frequencies is perfectly explained by the field configurations. ESA

N93-22686# Stanford Univ., CA. Linear Accelerator Center.
A VARIABLE CURRENT BYPASS SHUNT FOR ELECTROMAGNETS
M. M. Berndt and J. J. Lipari Nov. 1992 4 p Presented at the Nuclear Science Symposium, Orlando, FL, 26-31 Oct. 1992
(Contract DE-AC03-76SF-00515)
(DE93-004273; SU-SLAC-PUB-5987; CONF-921005-4) Avail: CASI HC A01/MF A01

An IGBT is used to control the current in bypass circuits that vary the relative strength of magnets connected in series. Each circuit consists of a water cooled assembly rated for continuous operation at 70 Volts and 0-50 Amperes DC, with 1 KV insulation between control/monitoring elements and magnets. The circuit operates as a 10KHz PWM switcher that includes filters and transient protection. DOE

N93-22688# Argonne National Lab., IL.
THE ANL ELECTRIC VEHICLE BATTERY R/D PROGRAM FOR DOE-EHP
1992 42 p
(Contract W-31-109-eng-38)
(DE93-005689; ANL/CMT/RP-76350) Avail: CASI HC A03/MF A01

The Electrochemical Program at Argonne National Laboratory (ANL) provides technical and programmatic support to DOE's Electric and Hybrid Propulsion Division (DOE-EHP). The goal of DOE-EHP is to advance promising electric-vehicle (EV) propulsion technologies to levels where industry will continue their commercial development and thereby, significantly reduce petroleum consumption in the transportation sector of the economy. In support of this goal, ANL provides research, development, testing/evaluation, post-test analysis, modeling, database management, and technical management of industrial R&D contracts on advanced battery and fuel cell technologies for DOE-EHP. This report summarizes the battery-related activities undertaken during the period of October 1, 1991 through March 31, 1992. In this report, the objective, background, technical progress, and status are described for each task. These tasks are structured into the following task areas: 1.0 Project Management and Coordination;

2.0 Lithium/Sulfide Batteries; 3.0 Advanced Sodium/Beta Batteries; 4.0 Advanced Ambient-Temperature Batteries; 5.0 eV Battery Performance and Life Evaluation. DOE

N93-22689# Argonne National Lab., IL.
THE ANL ELECTROCHEMICAL PROGRAM FOR DOE ON ELECTRIC VEHICLE R/D
1992 22 p
(Contract W-31-109-eng-38)
(DE93-005690; ANL/CMT/RP-78323) Avail: CASI HC A03/MF A01

The Electrochemical Technology Program at Argonne National Laboratory (ANL) provides technical and programmatic support to DOE's Electric and Hybrid Propulsion Division (DOE-EHP). The goal of DOE-EHP is to advance promising electric-vehicle (EV) propulsion technologies to levels where industry will continue their commercial development and thereby significantly reduce petroleum consumption in the transportation sector of the economy. In support of this goal, ANL provides research, development, testing/evaluation, post-test analysis, modeling, database management, and technical management of industrial R&D contracts on advanced battery technologies for DOE-EHP. This report summarizes the battery-related activities undertaken during the period of July 1, 1992 through September 30, 1992. In this report, the objective, background, technical progress, and status are described for each task. The work is organized into the following task areas: Project Management and Coordination; Lithium/Sulfide Batteries; Advanced Sodium/Beta Batteries; Advanced Ambient-Temperature Batteries; and EV Battery Performance and Life Evaluation. DOE

N93-22812*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CENTER FOR SPACE MICROELECTRONICS TECHNOLOGY Technical Report, 1991
Jul. 1992 105 p
(Contract NAS7-918)
(NASA-CR-192799; NAS 1.26:192799; JPL-Publ-92-13) Avail: CASI HC A06/MF A02

The 1991 Technical Report of the Jet Propulsion Laboratory Center for Space Microelectronics Technology summarizes the technical accomplishments, publications, presentations, and patents of the Center during the past year. The report lists 193 publications, 211 presentations, and 125 new technology reports and patents. Author

N93-22819# Oak Ridge National Lab., TN.
SENSOR-BASED WHOLE-ARM OBSTACLE AVOIDANCE UTILIZING ASIC TECHNOLOGY
A. L. Wintenberg, M. N. Ericson, S. M. Babcock, G. A. Armstrong, C. L. Britton, Jr., P. L. Butler, W. R. Hamel, and D. F. Newport (Tennessee Univ., Knoxville.) 1993 18 p Presented at the 5th Topical Meeting on Robotics and Remote Systems, Knoxville, TN, 26-29 Apr. 1993
(Contract DE-AC05-84OR-21400)
(DE93-003602; CONF-930403-4) Avail: CASI HC A03/MF A01

Operation of manipulator systems in poorly defined work environments often presents a significant hazard to both the robotic assembly and the environment. In applications relating to the Environmental Restoration and Waste Management (ER&WM) Program, many of the environments are considered hazardous, both, in the structure and composition of the environment. Use of a sensing system that provides information to the manipulator control unit regarding obstacles in close proximity will provide protection against collisions. A hierarchical design and implementation of a whole-arm obstacle avoidance system is presented. The system is based on capacitive sensors configured as bracelets for proximity sensing. Each bracelet contains a number of sensor nodes and a processor for sensor node control and readout, and communications with a higher level host, common to all bracelets. The host controls the entire sensing network and communicates proximity information to the manipulator controller. The overall architecture of this system is discussed with detail on the individual system modules. Details of an application specific integrated circuit (ASIC) designed to implement the sensor node electronics are presented. Justifications for the general measurement methods and associated implementation are discussed. Additionally, the current state of development including measured data is presented. DOE

N93-22821# Sandia National Labs., Albuquerque, NM.
SAFETY AND PERFORMANCE OF A LONG LIFE LITHIUM-THIONYL CHLORIDE BATTERY
W. R. Cieslak and H. K. Street 1992 7 p Presented at the 8th Annual Battery Conference on Applications and Advances, Long Beach, CA, 12-14 Jan. 1993
(Contract DE-AC04-76DP-00789)
(DE93-005348; SAND-92-2704C; CONF-930152-3) Avail: CASI HC A02/MF A01

A Li/SOCl2 'D' cell for applications requiring 10 to 15 years life at very low drain rates, typically less than 150 microA, were developed. Maximizing cell safety and reliability, while delivering very good energy density, were the goals. These goals were achieved by designing the cell to be application specific. The low-rate cell was optimized to deliver up to 16 Ah at drain rates of less than 70 mA. By virtue of its low surface area, 145 cm(sup 2), the cell demonstrated excellent safety behavior. Safety testing was performed on individual cells as well as on two-cell and four-cell batteries. Single cells did not vent when short-circuited. Benign venting in a two cell string was produced, but only when the string was partially discharged before shorting. The vent mechanism is a 300 psi rupture pressure burst disc manufactured by BS&B Safety Systems. Benign venting is defined as full opening of the 3/8 in. dia vent hole without deformation of the case. Material is expelled from the cell without flame, and the cell stack remains largely intact. Venting of the Sandia-designed low rate cell was not produced under any other abuse test conditions. The vent functions as an ultimate safety mechanism in the case of severe abuse, but resistance to venting under normal use and mild abuse conditions is key to the achievement of high reliability. DOE

N93-22945# Pacific Northwest Lab., Richland, WA.
CHARACTERISTICS OF IDENTIFYING LINEAR DYNAMIC MODELS FROM IMPULSE RESPONSE DATA USING PRONY ANALYSIS
D. J. Trudnowski Dec. 1992 97 p
(Contract DE-AC06-76RL-01830)
(DE93-005607; PNL-8450) Avail: CASI HC A05/MF A02

The purpose of the study was to investigate the characteristics of fitting linear dynamic models to the impulse response of oscillatory dynamic systems using Prony analysis. Many dynamic systems exhibit oscillatory responses with multiple modes of oscillations. Although the underlying dynamics of such systems are often nonlinear, it is frequently possible and very useful to represent the system operating about some set point with a linear model. Derivation of such linear models can be done using two basic approaches: model the system using theoretical derivations and some linearization method such as a Taylor series expansion; or use a curve-fitting technique to optimally fit a linear model to specified system response data. Prony analysis belongs to the second class of system modeling because it is a method of fitting a linear model to the impulse response of a dynamic system. Its parallel formulation inherently makes it well suited for fitting models to oscillatory system data. Such oscillatory dynamic effects occur in large synchronous-generator-based power systems in the form of electromechanical oscillations. To study and characterize these oscillatory dynamics, BPA has developed computer codes to analyze system data using Prony analysis. The objective of this study was to develop a highly detailed understanding of the properties of using Prony analysis to fit models to systems with characteristics often encountered in power systems. This understanding was then extended to develop general 'rules-of-thumb' for using Prony analysis. The general characteristics were investigated by performing fits to data from known linear models under controlled conditions. The conditions studied include various mathematical solution techniques, different parent system configurations, and a large variety of underlying noise characteristics. DOE

N93-22997# Lawrence Livermore National Lab., CA.
PULSE POWER REQUIREMENTS FOR LARGE APERTURE OPTICAL SWITCHES BASED ON PLASMA ELECTRODE POCKELS CELLS
M. A. Rhodes and J. Taylor Jun. 1992 5 p Presented at the 20th International Power Modulator Symposium, Myrtle Beach, SC, 23-25 Jun. 1992
(Contract W-7405-eng-48)
(DE93-005824; UCRL-JC-109579; CONF-920671-13) Avail: CASI HC A01/MF A01

We discuss very large-aperture optical switches (greater than 30 x 30

cm) as an enabling technology for inertial confinement fusion drivers based on multipass laser amplifiers. Large-scale laser fusion drivers such as the Nova laser have been based on single-pass amplifier designs in part because of the unavailability of a suitable large-aperture switch. We are developing an optical switch based on a Pockels cell employing plasma-electrodes. A plasma-electrode Pockels cell (PEPC) is a longitudinal-mode Pockels cell in which a plasma discharge is formed on each side of an electro-optic crystal (typically KDP or deuterated KDP, often designated KD*P). The plasmas formed on either side of the crystal act as transparent electrodes for a switching-pulse and are intended to allow uniform charging of the entire crystal. The switching-pulse is a nominally rectangular high-voltage pulse equal to the half-wave voltage V(sub x) (8 kV for KD*P or 17 kV for KDP) and is applied across the crystal via the plasma-electrodes. When the crystal is charged to V(sub x), the polarization of an incoming, linearly polarized, laser beam is rotated by 90 degree. When used in conjunction with an appropriate, passive polarizer, an optical switch is thus realized. A switch with a clear aperture of 37 x 37 cm is now in construction for the Beamlet laser which will serve as a test bed for this switch as well as other technologies required for an advanced NOVA laser design. In this paper, we discuss the unique power electronics requirements of PEPC optical switches. DOE

N93-22999# Lawrence Livermore National Lab., CA.
MONTE CARLO MODELING OF SOLID-STATE PHOTOSWITCHES
P. W. Rambo and J. Denavit Dec. 1992 12 p Presented at the International Society for Optical Engineering Conference, Los Angeles, CA, 18-22 Jan. 1993
(Contract W-7405-eng-48)
(DE93-005829; UCRL-JC-111268; CONF-930159-2) Avail: CASI HC A03/MF A01

Large increases in conductivity induced in GaAs and other semiconductors by photoionization allow fast switching by laser light with applications to pulse-power technology and microwave generation. Experiments have shown that under high-field conditions (10 to 50 kV/cm), conductivity may occur either in the linear mode where it is proportional to the absorbed light, in the 'lock-on' mode, where it persists after termination of the laser pulse or in the avalanche mode where multiple carriers are generated. We have assembled a self-consistent Monte Carlo code to study these phenomena and in particular to model hot electron effects, which are expected to be important at high field strengths. DOE

N93-23021# Technische Univ., Delft (Netherlands).
DESIGN OF LOW-VOLTAGE BIPOLAR OPERATIONAL AMPLIFIERS Ph.D. Thesis
Jeroen Fonderie 1992 207 p
(ISBN-90-9004571-6; ETN-93-93471) Copyright Avail: CASI HC A10/MF A03

The design of input stages for low voltage Operational Amplifiers (OpAmps) is considered. The purpose of this design emanates from the objective of having a common mode input voltage range that reaches from one supply rail to the other, and designs that have this feature both at a 2 V and at a 1 V supply are discussed. Possible output stage configurations are analyzed. This discussion is restricted to output stages that have an output voltage range that also reaches from rail to rail. Further, the output stage should be able to supply a sufficiently large output current to the load that is externally connected to the OpAmp. The frequency response of the output stage is the focus of the discussion. The circuit parts that remain to complete the design of the OpAmp are discussed. These circuit parts are the intermediate stage, inserted between the input and output stage to boost the overall gain of the OpAmp, some implementations of the class AB current control circuit, circuitry to protect the output transistor from heavy saturation and from excessive power consumption, and, finally, the proportional to absolute temperature reference current generator. A detailed analysis of the frequency compensation techniques that can be used to stabilize the OpAmp is given. From this theory, design criteria to successfully implement the compensation method are derived. The experimental OpAmp designs and the measurements performed on these designs are described. Conclusions and suggestions for further research are given. ESA

N93-23041*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DESIGN AND QUALIFICATION OF THE SEU/TD RADIATION MONITOR CHIP
Martin G. Buehler, Brent R. Blaes, George A. Soli, Nasser Zamani, and Kenneth A. Hicks 1 Oct. 1992 52 p
(Contract NAS7-918)
(NASA-CR-192797; NAS 1.26:192797; JPL-Publ-92-18) Avail: CASI HC A04/MF A01

This report describes the design, fabrication, and testing of the Single-Event Upset/Total Dose (SEU/TD) Radiation Monitor chip. The Radiation Monitor is scheduled to fly on the Mid-Course Space Experiment Satellite (MSX). The Radiation Monitor chip consists of a custom-designed 4-bit SRAM for heavy ion detection and three MOSFET's for monitoring total dose. In addition the Radiation Monitor chip was tested along with three diagnostic chips: the processor monitor and the reliability and fault chips. These chips revealed the quality of the CMOS fabrication process. The SEU/TD Radiation Monitor chip had an initial functional yield of 94.6 percent. Forty-three (43) SEU SRAM's and 14 Total Dose MOSFET's passed the hermeticity and final electrical tests and were delivered to LL.
Author (revised)

N93-23112# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Bereich Industrielle Messtechnik und Informationsverarbeitung.
PROGRESSES IN MEASURING ELECTROSTATIC DC FIELDS
Frank Buschbeck Apr. 1992 20 p
(OEFZS-4627; ETN-93-93450) Copyright Avail: CASI HC A03/MF A01

Innovations in measurement techniques for electrostatic Direct Current (DC) fields since 1972 are presented. The starting point was the theoretical understanding of the error mechanisms which causes random zeropoint shifts in the conventional DC field meters due to surface pollution. From this theory the basic rule applicable for the design of much more stable measurement devices is derived. The long term instability of these devices is now in the order of only 1 V/m. One particular solution is the 'variable gap fieldmill'. Several vibrating sensor configurations with very low sensitivity to surface pollution are proposed. A general method to improve traditional devices, such as the well known 'covering fieldmill' and some vibrating sensors, is given. For the 'cylindrical fieldmill', a method was developed which allows the simultaneous measurements of field strength, polarity, and the direction to the field source. ESA

N93-23205# National Inst. of Standards and Technology, Gaithersburg, MD.
NIST MESUREMENT SERVICE FOR DC STANDARD RESISTORS Final Technical Note
Ronald F. Dziuba, Paul A. Boynton, Randolph E. Elmquist, Dean G. Jarrett, Theodore P. Moore, and Jack D. Neal Nov. 1992 67 p
(PB93-139079; NIST/TN-1298) Avail: CASI HC A04/MF A01

At the National Institute of Standards and Technology (NIST), the U.S. representative of the ohm is based on the quantum Hall effect, and it is maintained and disseminated at various resistance levels by working reference groups of standards. This document describes the measurement systems and procedures used to calibrate standard resistors of nominal decade values in the resistance range from 10(exp -4) ohm to 10(exp 12) ohm. Resistance scaling techniques used to assign values to the working standards are discussed. Also included is an assessment of the calibration uncertainties at each resistance level. GRA

N93-23319# Argonne National Lab., IL.
ANALYSIS AND CORRECTION OF NOISE ON ELECTRONIC CIRCUITS IN AN ACCELERATOR ENVIRONMENT
M. Fathizadeh, O. D. Despe, and D. G. McGhee 1992 4 p Presented at the Nuclear Science Symposium, Orlando, FL, 26-31 Oct. 1992
(Contract W-31-109-eng-38)
(DE93-004816; ANL/ASD/VU-76158; CONF-921005-18) Avail: CASI HC A01/MF A01

Accelerator noise sources can cause both analog and digital electronic circuits to malfunction. This paper identifies and analyzes noise sources, and describes the methodology for measurement. Both general remedies and specific solutions to minimize the noise effects on accelerator electronic circuits are described. A policy for electronic design, board layout, assembly,

and fabrication is established. Conclusions are drawn based on theoretical principles with practical examples shown in case studies. DOE

N93-23366# Helsinki Univ. of Technology, Espoo (Finland). Physical Metallurgy and Materials Science Lab.

AMORPHOUS DIFFUSION BARRIERS FOR ELECTRONIC DEVICE APPLICATIONS Ph.D. Thesis

Pekka Pokela (California Inst. of Tech., Pasadena.) 1991 162 p Sponsored by Suomen Akatemia; Finnish Cultural Foundation; Lohja Corp.; Raakel and Antti Wihuri Foundation; and ARO

(ETN-93-93476) Avail: CASI HC A08/MF A02

Fundamental concepts of producing reliable contacts in silicon technology are overviewed. Diffusion barrier types and their relevant properties are classified and discussed on the basis of the existing knowledge and recent progress. Amorphous binary and ternary nitride diffusion barriers are investigated in a number of silicon contact metallizations and Al/Au thin film couples. The diffusivity as well as the oxidation behavior of these barriers are studied. It is noted that to realize metallurgically stable contacts, the chemical stability of the barrier elements with the adjacent materials and the amorphous structure of the barrier appear as major attributes that, combined, lead to an excellent barrier performance which often exceeds that of conventional diffusion barriers. Based on that idea, a general concept for choosing an optimal diffusion barrier for a given application is presented. Eight appendices are included covering: Si/X/Cu contacts in which both amorphous and crystalline forms of W-N thin films are considered; testing of the effectiveness of the amorphous ternary Ta-Si-N films in various multilayer contacts on silicon by electrical measurements; the investigation of the amorphous Ta-Si-N thin film barrier in the Si/Au and Al/Au contacting schemes; the failure mechanisms in those systems; the determination of relevant properties like diffusivity and oxidation kinetics in amorphous binary W-N and ternary Ta-Si-N diffusion barriers. ESA

N93-23394*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SIMULATION OF TUNNELADDER TRAVELING-WAVE TUBE COLD-TEST CHARACTERISTICS: IMPLEMENTATION OF THE THREE-DIMENSIONAL, ELECTROMAGNETIC CIRCUIT ANALYSIS CODE MICRO-SOS

Carol L. Kory (Ohio Aerospace Inst., Brook Park.) and Jeffrey D. Wilson Mar. 1993 16 p

(RTOP 506-44-2B)

(NASA-TP-3294; E-7008; NAS 1.60:3294) Avail: CASI HC A03/MF A01

The three-dimensional, electromagnetic circuit analysis code, Micro-SOS, can be used to reduce expensive time-consuming experimental 'cold-testing' of traveling-wave tube (TWT) circuits. The frequency-phase dispersion characteristics and beam interaction impedance of a TunneLadder traveling-wave tube slow-wave structure were simulated using the code. When reasonable dimensional adjustments are made, computer results agree closely with experimental data. Modifications to the circuit geometry that would make the TunneLadder TWT easier to fabricate for higher frequency operation are explored. Author (revised)

N93-23433# Massachusetts Inst. of Tech., Cambridge. Electronics Research Lab.

THREE DIMENSIONAL TRANSIENT ANALYSIS OF MICROSTRIP CIRCUITS IN MULTILAYERED ANISOTROPIC MEDIA Annual Report, 1 Oct. 1991 - 30 Sep. 1992

J. A. Kong 26 Jan. 1993 47 p

(Contract N00014-90-J-1002)

(AD-A259829) Avail: CASI HC A03/MF A01

The finite difference-time domain (FD-TD) technique is applied to the solution of Maxwell's equations. A computer program, which can be used to simulate and study numerous electromagnetic phenomena, is developed and implemented on an IBM 386 compatible personal computer. The FD-TD technique is a useful tool for students in electromagnetics. The technique is flexible and can be applied to many basic EM scattering and radiation problems. Because field solutions are found as a function of time, visualization of the propagation of the EM fields is possible. The FD-TD technique is implemented for a two-dimensional rectangular grid in conjunction with a second-order absorbing boundary condition. Both E- and H-field polarizations are analyzed. Finite objects consisting of dielectric, magnetic and conducting materials, and perfectly conducting infinite ground planes are modeled. Plane wave and line current sources are implemented. In addition to the capability of animating the propagation of the EM fields, radiation and scattering patterns can be generated. GRA

N93-23483# General Atomic Co., San Diego, CA.

30 KA, 5000 V SOLID-STATE OPENING SWITCH FOR INDUCTIVE ENERGY STORAGE Final Report, Apr. 1990 - Nov. 1992

Mark W. Heyse, James B. Cornette, Nolan E. Taconi, Ed E. Bowles, and W. G. Homeyer Jan. 1993 11 p

(Contract F08635-90-C-0241)

(AD-A259763; WL-TP-92-012; XC-WL/ELGIN) Avail: CASI HC A03/MF A01

Inductive energy stores have demonstrated higher energy storage densities than capacitive energy stores. A limitation in the use of inductive energy stores has been the availability of adequately rated opening switches. A self-commutated solid-state switch has been developed for use as an opening device for an inductive energy store. A single switch module is rated at 30 kA and 5000 V. The charging pulse lengths for the intended application vary from 0.1 to 5 seconds. Efficiency and volumetric power density were optimized. The switch topology is a two-stage hybrid consisting of an SCR-FET/SCR-IGBT combination. The switch is designed to charge an inductive energy store and repetitively commutate the current to a railgun load. The first of ten switch modules for a 250 kA switch has been built and successfully tested on a battery test stand. The theory of operation, circuit topology, and test results are given in this paper. GRA

N93-23487# Wright Lab., Eglin AFB, FL.

LIGHT-ACTIVATED SOLID-STATE OPENING SWITCH Final Report, Apr. 1990 - Mar. 1992

Mark W. Heyse, Rodney A. Petr, George I. Kachen, James P. Reilly, and Raymond B. Schaefer Jan. 1993 10 p

(Contract F08635-90-C-0243)

(AD-A259770; WL-TP-92-011) Avail: CASI HC A02/MF A01

Light-activated solid-state opening switches are shown to be a viable approach for switching inductive circuits. Measured photoswitch performance indicates that light-activated opening switches have the power density ratings needed to develop compact inductive power systems. GRA

N93-23498 California Univ., Irvine.

STUDY OF A PLASMA-FILLED X-BAND BACKWARD WAVE OSCILLATOR Ph.D. Thesis

Xiaoling Zhai 1992 121 p

Avail: Univ. Microfilms Order No. DA9233705

The plasma-filled Backward Wave Oscillator (BWO) is a very promising but poorly understood high power microwave device. The goal of this experimental investigation was to measure the electric field in a plasma-filled BWO by the spectroscopic analysis of the plasma light emission. The measurement was done directly in the region where the plasma, relativistic electron beam and RF interact. We also hoped to shed some light on how the microwave frequency, power and bandwidth depended on the background plasma density. Our vacuum BWO microwave output was 100 MW at a frequency of 8.5 GHz and bandwidth (delta-f/f(sub 0)) of 6 percent. The efficiency of converting the beam kinetic energy into electromagnetic radiation was 5 percent. When we filled the BWO with background plasma, up to a factor of 7 enhancement in the microwave power output over its vacuum counterpart appeared at a background plasma density of 8 x 10(exp 11) cm(exp -3), with a frequency upshift of 1 GHz and a bandwidth (delta f/f(sub 0)) of 24 percent. Mode switching appeared at a background helium plasma density of 10(exp 12) cm(exp -3). The electric field strength, measured by the Stark shift, peaked at 34 kV/cm and lasted as long as the microwave pulse. Trivelpiece-Gould modes appeared at 2 GHz to 5 GHz in the plasma-filled BWO. Mode competition between the Trivelpiece-Gould mode and the X-band TM(exp 01) mode occurred when the background plasma density was below 6 x 10(exp 11) cm(exp -3). At a critical background plasma density of n(sub cr) approx. equals 8 x 10(exp 11) cm(exp -3), power enhancement appeared in both X-band and the Trivelpiece-Gould modes. When the background plasma density increased from 6 x 10(exp 11) cm(exp -3) to 8 x 10(exp 11) cm(exp -3), power enhancement of the S-band in this mode collaboration region reached up to 8 dB. Dissert. Abstr.

N93-23501# Farrington Lockwood Co. Ltd., Kanata (Ontario).
STUDY ON THE IMPROVED RELIABILITY AND SAFETY OF LITHIUM BATTERIES BY THE USE OF ELECTROCHEMICAL NOISE MEASUREMENT, VOLUME 1 Final Report
Wing S. Nip, Timothy J. Patraboy, James S. Anderson, Geoff Rodgers, and Michael D. Farrington 28 Feb. 1992 88 p
(Contract DSS-W2207-9-AF06/01-SV)
(FL-D-22-Vol-1; CTN-93-60677) Avail: CASI HC A05/MF A01

Investigations were conducted into the applicability of electrochemical noise measurement as a tool for diagnosing the state of health and state of charge in lithium batteries. Electrochemical noise is understood to mean the alternating current component of an otherwise direct current measured at the external terminals of the battery, especially random or periodic fluctuations at a microscopic level. A survey of ten commercial primary lithium cell products included three chemical systems (SO2, SOCl2, and MnO2) in a variety of sizes from coin cells to D size from several manufacturers. The cells were subjected to a systematic study of the relationship between noise and rate of discharge, temperature of discharge, temperature cycling, high temperature storage, and vibration exposure. Noise measurements were paralleled with alternating current impedance measurements for comparison. It became clear during the investigations that when a noise measurement identified a cell that was significantly different from the norm, it was a bad cell that would fail to deliver its rated capacity or would present a safety hazard. Often changes in the noise from a given cell were accompanied by changes in some impedance parameters; these changes appeared to be related. Noise measurements were sensitive to many elements of the cell history. CISTI

N93-23656# Army Lab. Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.
A REVIEW OF OPTICALLY CONTROLLED MICROWAVE DEVICES AND CIRCUITS Technical Report, Jun. 1991 - Jun. 1992
Arthur Paolella Sep. 1992 31 p
(AD-A259647; SLCET-TR-92-11) Avail: CASI HC A03/MF A01

The combining of optical and microwave technology is imminent, especially the integration of optical and microwave circuit functions on the same circuit or chip. Since the MESFET is the main active component of the GaAs MMIC, it makes sense to explore its properties as an optical detector for the detection of microwave and control signals in fiber optic links. This report is a review of the state of the art in the control of microwave devices and circuits by optical means. First, the use of the MESFET as the optical detector for the control of microwave circuits will be reviewed. Then, investigation for the optical control of microwave devices such as the Gunn device, impact ionization avalanche transit time device (IMPATT), high electron mobility transistor (HEMT), and bipolar transistor will be presented. Finally, different types of photodetectors are discussed and compared with the MESFET. GRA

N93-23665# Quad Design Technology, Inc., Camarillo, CA.
APPLICABILITY OF SUPERCONDUCTING INTERCONNECTION TECHNOLOGY FOR HIGH SPEED IC'S AND SYSTEMS Final Quarterly Report
Oct. 1992 188 p
(Contract N00014-90-C-0217)
(AD-A259706) Avail: CASI HC A09/MF A02

The extremely low-loss characteristics of HTSC interconnect renders it an attractive candidate for high density-high performance digital circuitry. The purpose of this program was to investigate these properties in detail, and to determine the characteristics of systems that can best exploit these properties. To this end, a study was undertaken to more fully characterize the limitations of conventional interconnects, in particular, in the context of source-terminated CMOS devices, a technology well-adapted to cryogenic applications. Thermal and mechanical considerations of HTSC-MCM technology were explored as well as part of this effort. Applying Rent's Rule to system connection requirements, it was determined that HTSC interconnects can significantly reduce the required levels of wiring and/or increase the packing density of conventionally partitioned IC's on an MCM. This advantage is amplified if IC's are first optimized for MCM application (eg. using larger numbers of area-I/O pads at the chip levels). GRA

N93-23677# Sandia National Labs., Albuquerque, NM.
HIGH-VOLTAGE FAILURE MECHANISMS IN LIQUID-FILLED, FLUORINERT FC-40, CAPACITORS
J. D. McBrayer, C. B. Richardson, A. A. Jojola, and L. J. Pitre 1992 7 p Presented at the 13th Capacitor and Resistor Technology Symposium, Costa Mesa, CA, 8-11 Mar. 1993
(Contract DE-AC04-76DP-00789)
(DE93-006286; SAND-92-1981C; CONF-930394-1) Avail: CASI HC A02/MF A01

The high-voltage electrical failure of a liquid-filled, FC-40 Fluorinert, capacitor occurred during a system random vibration test. This failure occurred between 1 and 5 hours of random vibration of the system in the longitudinal axis of the capacitor. The previous five hours of random vibration in the transverse direction left the capacitor functioning as designed. Similar failures were observed during component random vibration testing under high-voltage. This paper will describe the investigation of the above mentioned failures. The design and processing of this type of capacitor technology will also be reviewed. Both electrical and mechanical data will be provided. The results of this investigation revealed the cause of the above failures and the procedures necessary for avoiding such failures in the future. The interaction of the mechanical system, piece-part designs and the bellows temperature compensation system will be explained in connection with the electrical failures. Suggestions for future improved designs will be included. DOE

N93-23695# Maryland Univ., College Park.
STUDIES OF THE LONGITUDINAL INSTABILITY WITH AN ELECTRON BEAM
1993 15 p
(Contract DE-FG02-92ER-54178)
(DE93-006513; DOE/ER-54178/1) Avail: CASI HC A03/MF A01

Goals for our first-year period are as follows: To study the evolution of a small perturbation in the current pulse (introduced via the grid voltage on the electron gun) when the beam propagates through our 5-m long periodic solenoid channel. Specifically, to see if the perturbation is reflected from the rear end of the pulse. So far these objectives have been met without any delays. We were able to launch different perturbations on the beam resulting in either a slow space-charge wave or a fast wave or both waves. The relative strength of each wave was found to depend on the electron emission temperature of the cathode. The propagation of these waves on an initially rectangular longitudinal beam profile was measured with fast current monitors and the kinetic energy was measured with sensitive energy analyzers at various positions along the 5-m long solenoidal focusing channel. We have also begun to study the behavior of the waves when they reach the respective edge of the beam. But this work is still of a preliminary nature, and we need to refine the beam conditions and measurements in future studies to reach any firm conclusions. Preparations for the resistive-wall instability experiment are in progress. DOE

N93-23728# Farrington Lockwood Co. Ltd., Kanata (Ontario).
STUDY ON THE IMPROVED RELIABILITY AND SAFETY OF LITHIUM BATTERIES BY THE USE OF ELECTROCHEMICAL NOISE MEASUREMENT, VOLUME 2 Final Report
Wing S. Nip, Timothy J. Patraboy, James S. Anderson, Geoff Rodgers, and Michael D. Farrington 28 Feb. 1992 187 p
(Contract DSS-W2207-9-AF06/01-SV)
(FL-D-22-Vol-2; CTN-93-60693) Avail: CASI HC A09/MF A02

Electrochemical noise measurements were made and analyzed in order to study the reliability of various kinds of lithium primary cells. Sample tracking codes, figures relating to the main report showing performance results such as the cell voltage and noise voltage versus time, and a database on cell discharge behavior are provided. A literature review is also included on the categorization of noise, the interpretation and modelling of electrochemical noise, and examples of electrochemical noise studies. From the review, it is apparent that electrochemical noise measurements can provide very sensitive information, and are sometimes the only way to study certain electrochemical phenomena. Problems with such studies include the difficulty of quantitative interpretation of the data and the need to focus attention on the low-frequency component of the noise, which is the only portion of the noise that can be interpreted with any confidence. CISTI

N93-23743*# Sverdrup Technology, Inc., Brook Park, OH.
CHARACTERISTICS OF LINEARLY TAPERED SLOT ANTENNA WITH CPW FEED ON HIGH RESISTIVITY SILICON
Rainee N. Simons, Susan R. Taub, and Richard Q. Lee Mar. 1993 6 p Proposed for presentation at the 1993 IEEE AP-S International Symposium and URSI Radio Science Meeting, Ann Arbor, MI, 27 Jun. - 2 Jul. 1993; sponsored by the IEEE and USNC Commissions A, B, D, and F Sponsored by NASA. Lewis Research Center
(RTOP 506-44-2C)
(NASA-TM-106057; E-7658; NAS 1.15:106057) Avail: CASI HC A02/MF A01

A linearly tapered slot antenna (LTSA) has been fabricated on a high resistivity silicon substrate and tested at C-Band frequencies. The LTSA is electromagnetically coupled to a coplanar waveguide (CPW) feed. In this paper, the measured radiation patterns, gain, and return loss are presented and discussed. Author

N93-23863# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France). Groupe Systemes Integres de Perception.
STUDY OF THE COMPATIBILITY OF PIN DETECTOR CIRCUITS AND FIELD EFFECT TRANSISTORS. EXTENSION TO HIGH MOBILITY AND ONE DIMENSIONAL ELECTRON GAS TRANSITORS Ph.D. Thesis - Toulouse Univ.
Michel DaSilva 1992 156 p In FRENCH; ENGLISH summary
(LAAS-92242; ETN-93-93686) Avail: CASI HC A08/MF A02

The results of a study of the compatibility between PIN circuits and heterojunction field effect transitors are presented. This structure gives good performances and it allows monolithic integration on semi-insulating substrate. The analysis of the photodetector properties defines the conception rules and optimizes the electrical and technological parameters spectral response, sensitivity, and speed. These rules give the design of field effect transistors compatible for the photodetection. Such a transistor presents a high value of transconductance and a low ratio between the square of the capacity and the transconductance. The results of the structure designs based on the previous rules show compatibility between the preamplifier and the PIN or metal semiconductor metal photodetectors. The devices were fabricated from heterojunctions grown in a semi-insulating GaAs substrate. The work done is satisfactory for the layer growth, the region lithography, the contact metallization part, and the device electrical characteristic activities. To further increase the circuit performances, the photodetector will integrate resonant cavity detectors and one dimensional electron gas field effect transistor. ESA

N93-24010# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
EVALUATION OF A NICKEL/METAL HYDRIDE BATTERY FOR A LOAD CONDITIONER
K. Kumai, T. Ikeya, T. Iwahori, and S. Sakai (Furukawa Battery Co. Ltd., Japan.) Apr. 1992 52 p
(DE93-761824; CRIE-T-91033) Avail: CASI HC A04/MF A01

An evaluation was given on applicability of Ni/metal hydride battery (AA-size, 1 Wh) to a load conditioning application. Unit cells and multicell batteries (series and parallel connections) were tested of their basic characteristics under charge and discharge conditions. The volumetric energy density of the Ni/metal hydride battery is 175 Wh/l, 2.5 times that of lead-acid batteries. The battery has an energy efficiency of 88 to 90 percent and superior output characteristics satisfying the development targets. On the other hand, it was found that the battery has optimal conditions in specific charging methods (potential regulating method, time regulating method, and constant voltage and constant current method). To operate the battery at a high efficiency and for a long life, the constant current and constant voltage charge would be most advantageous, but the charge method requires further improvements and discussions. In five-cell series and parallel operation tests, difference in the capacity and the internal resistance was the factor to vary the charge/discharge characteristics, but the efficiency was about the same as that of unit cells. DOE

N93-24023# Varian Associates, Palo Alto, CA.
HIGH TEMPERATURE SUPERCONDUCTIVITY Quarterly Report, period ending 30 Sep. 1992
James N. Eckstein 11 Dec. 1992 4 p
(Contract N00014-88-C-0760)
(AD-A259692) Avail: CASI HC A01/MF A01

The overall goals of this program are to develop the technology of MBE (Molecular Beam Epitaxy), growth of HTSC (High Temperature Superconductors) material, to optimize the performance of HTSC films with high transition temperatures and critical current densities, and to explore the development of electronic devices based on such material. During this period work focussed on learning how to grow the 123-phase semiconductor by atomic layering. The atomic absorption system was used to measure Dy and Ba. fluxes. The absorbance of Dy is somewhat low, by utilizing careful measurement techniques sufficiently precise measurements were obtained. Growth of the 123-phase under conditions similar to those used for growth of the Bi-family superconductors gave smooth surfaces and sharp transitions with a zero resistance temperature of more than 89 K. GRA

N93-24027# Argonne National Lab., IL.
VARIABLE PRESSURE INSULATING JACKETS FOR HIGH-TEMPERATURE BATTERIES
P. A. Nelson, A. A. Chilenskas, and R. F. Malecha 1992 7 p Presented at the 27th Intersociety Energy Conversion Engineering Conference, San Diego, CA, 3-7 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-006404; ANL/CMT/CP-75182; CONF-920801-29) Avail: CASI HC A02/MF A01

A new method is proposed for controlling the temperature of high-temperature batteries namely, varying the hydrogen pressure inside of multifoil insulation by varying the temperature of a reversible hydrogen getter. Calculations showed that the rate of heat loss through 1.5 cm of multifoil insulation between a hot-side temperature of 425 C and a cold-side temperature of 25 C could be varied between 17.6 W/m(sup 2) and 7,000 W/m(sup 2). This change in heat transfer rate can be achieved by varying the hydrogen pressure between 1.0 Pa and 1,000 Pa, which can be done with an available hydrogen gettering alloy operating in the range of 50 C to 250 C. This approach to battery cooling requires cylindrical insulating jackets, which are best suited for bipolar batteries having round cells approximately 10 to 18 cm in diameter. DOE

N93-24068# Texas Univ., Austin. Electronics Research Center.
JOINT SERVICES ELECTRONICS PROGRAM. BASIC RESEARCH IN ELECTRONICS (JSEP) Final Report, 1 Apr. 1989 - 30 Jun. 1992
Edward J. Powers 1 Aug. 1992 29 p
(Contract F49620-89-C-0044)
(AD-A259598; TR-46; AFOSR-92-1013TR) Avail: CASI HC A03/MF A01

This final report summarizes research carried out by nine faculty and approximately eighteen graduate students at The University of Texas at Austin under the auspices of the Joint Services Electronics Program. This research program consists of five research units in solid-state electronics, two in electromagnetics, and two in information electronics. Solid-state electronics includes work in growth of III-V compounds by MBE, epitaxial growth of III-V semiconductor surfaces, charge transport in novel device-structures and materials, femtosecond processes in III-V semiconductors, and heterostructure device development. Information electronics includes multisensor signal processing, and nonlinear estimation and stochastic adaptive control. Research in electromagnetics involves millimeter wave active guided wave structures, and nonlinear wave phenomena. GRA

N93-24072# Polytechnic Univ., Farmingdale, NY.
DIELECTRIC FOR THE SUPERCAPACITORS Final Report, 1 Sep. 1989 - 31 Aug. 1992
S. Petrucci Dec. 1992 8 p
(Contract DAAL03-89-K-0148)
(AD-A260124; ARO-26636.4-CH) Avail: CASI HC A02/MF A01

The main purpose of the research program (Sep. 1989 - Sep. 1992) has been to offer chemists or engineers (interested in building a high density capacitor, capable of storing electrical energy, to be delivered continuously or by short pulses) the knowledge of the dielectric spectrum of relevant polar-apolar liquid mixtures, in a frequency range as broad as possible. This would enable the construction of capacitors using liquids of

known dielectric properties at frequencies as high as feasible. To this end we have extended the microwave frequency range to 130 GHz (1 GHz = 10(exp 9) Hz). The dielectric far-infrared to infrared range from 0.9 to 150 THz (1 THz = 10(exp 12)Hz) or 30/cm to 5000/cm in wave numbers is explored. This has required the procurement (through another grant of the school) of a FTIR spectrometer covering the above range, which was adapted to our purpose. Extension of the determination of the real part of the permittivity of the solution e1 = n2 to visible frequencies, namely to the doublet emission line of Na at lambda = 589.3 nm, by conventional high precision visible refractometry, was also accomplished with the purchase and setting up of a Bellingham and Stanley high precision refractometer capable of determining n(sub D) to within + or - 1 x 10(exp -5). At about the end of the grant tenure, the imaginary part of the complex permittivity e vs frequency was interpreted in the far infrared range (for organic carbonate solutions in apolar solvents) by the Powles-Rocard resonant-relaxation function 2, which modifies the Debye relaxation function by retention of inertial effects. Four systems of liquid mixtures were explored. GRA

N93-24129# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
HIGH TEMPERATURE SUPERCONDUCTING COMPOUNDS Final Report, 1 Sep. 1987 - 30 Sep. 1992
Allen M. Goldman 30 Nov. 1992 19 p
(Grant AF-AFOSR-0372-87)
(AD-A259926; AFOSR-93-0003TR) Avail: CASI HC A03/MF A01

The major accomplishment of this grant has been to develop techniques for the in situ preparation of high-Tc superconducting films involving the use of ozone-assisted molecular beam epitaxy. The techniques are generalizable to the growth of trilayer and multilayer structures. Films of both the DyBa2Cu3O(7-x) and YBa2Cu3O(7-x) compounds as well as the La(2-x)Sr(x)CuO4 compound have been grown on the usual substrates, SrTiO3, YSZ, MgO, and LaAlO3, as well as on Si substrates without any buffer layer. A bolometer has been fabricated on a thermally isolated SiN substrate coated with YSZ, an effort carried out in collaboration with Honeywell Inc. The deposition process facilitates the fabrication of very thin and transparent films creating new opportunities for the study of superconductor-insulator transitions and the investigation of photo-doping with carriers of high temperature superconductors. In addition to a thin film technology, a patterning technology has been developed. Trilayer structures have been developed for FET devices and tunneling junctions. Other work includes the measurement of the magnetic properties of bulk single crystal high temperature superconductors, and in collaboration with Argonne National Laboratory, measurement of electric transport properties of T1-based high-Tc films. GRA

N93-24131# Harry Diamond Labs., Adelphi, MD.
PROCESSING OF PATTERNED FERROELECTRIC CAPACITORS Final Report, Jan. - Sep. 1991
Bernard J. Rod Sep. 1992 26 p
(AD-A259936; HDL-TR-2202) Avail: CASI HC A03/MF A01

Processing steps are described in detail for a procedure to fabricate sol-gel-derived lead-zirconate-titanate (PZT) ferroelectric thin-film capacitors in a manner compatible with processed complementary metal-oxide-semiconductor (CMOS) integrated-circuit wafers. The intended purpose of this work is to fabricate nonvolatile-element memory test structures for electrical and radiation characterization studies. A number of critical processing issues dealing with the etching of the PZT films and the deposition and definition of the top and bottom platinum electrodes were addressed and suitable solutions found during the course of this work. Using the procedures described herein, we fabricated working PZT capacitors and evaluated them electrically. GRA

N93-24151# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
FORMATION OF DEFECT-FREE METAL/SEMICONDUCTOR CONTACTS Final Report, 10 Apr. 1986 - 31 Dec. 1991
John H. Weaver 15 Dec. 1992 14 p
(Contract N00014-86-K-0427)
(AD-A259604) Avail: CASI HC A03/MF A01

This program focused on the growth of metallic overlayers on semiconductor surfaces. Its goal was to investigate interface chemistry for a wide variety of metal-semiconductor systems and determine the growth structures produced by varying the metal and the processes of deposition. It was hoped that defect-free interfaces could be created by controlling the chemistry or the growth process itself. Indeed, a process involving cluster deposition was developed and shown to give interfaces that were free of conventional semiconductor defects. Throughout this program, modern surface science techniques were used to investigate the chemical and physical properties of metal-semiconductor interfaces. Over a six year period, a large amount of information regarding semiconductor surface disruption induced by the growing metal overlayers, interface intermixing, and overlayer structures was collected. GRA

N93-24164# Technical Univ. of Denmark, Lyngby.
ORGANIC ELECTROLYTES FOR SODIUM BATTERIES Final Report, 1 Apr. 1990 - 31 Mar. 1992
B. Vestergaard Sep. 1992 133 p
(AF Proj. 3145)
(AD-A260242; WL-TR-92-2114) Avail: CASI HC A07/MF A02

A summary of earlier given status reports in connection with the project on organic electrolytes for sodium batteries is presented. The aim of the investigations was to develop new room temperature molten salts electrolytes mainly with radical substituted heterocyclic organic chlorides mixed with aluminum chloride. The new electrolytes should have an ionic conductivity comparable with MEIC1:AlCl3 or better. A computer model program MOPAC (Molecular Orbital Package) was to be included to calculate theoretically reduction potentials for a variety of organic cations. Furthermore, MOPAC could be utilized to predict the electron densities, and then give a prediction of the stability of the organic cation. GRA

N93-24166# Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
MONTE CARLO SIMULATION OF HIGH-FIELD ELECTRON TRANSPORT IN ALTERNATING-CURRENT THIN-FILM ELECTROLUMINESCENT DEVICES
K. Bhattacharyya, S. M. Goodnick, and J. F. Wager 1993 7 p
(Contract DAAL03-91-G-0242)
(AD-A260274; ARO-28852.3-PH) Avail: CASI HC A02/MF A01

An ensemble Monte Carlo simulation of electron transport in bulk ZnS at high electric fields is presented. Scattering mechanisms associated with polar optical phonons, acoustic phonons (through deformation potential coupling), intervalley scattering, and impurities (neutral and ionized) are included in a nonparabolic multi-valley model. The simulated results show that energetic electrons are available for impact excitation at fields exceeding 1 MV/cm, and that transient effects are negligible in explaining measured efficiencies in alternating-current thin-film electroluminescent (ACTFEL) devices. GRA

N93-24225# National Inst. of Standards and Technology, Gaithersburg, MD. Semiconductor Electronics Div.
ELECTRONICS AND ELECTRICAL ENGINEERING LABORATORY TECHNICAL PUBLICATION ANNOUNCEMENTS COVERING LABORATORY PROGRAMS, APRIL TO JUNE 1992, WITH 1992/1993 EEEL EVENTS CALENDAR
E. J. Walters, comp. Dec. 1992 24 p
(PB93-147163; NISTIR-4997) Avail: CASI HC A03/MF A01

The document is the thirty-third issue of a quarterly publication providing information on the technical work of the National Institute of Standards and Technology Electronics and Electrical Engineering Laboratory (EEEL). This issue of the EEEL Technical Publication Announcements covers the second quarter of calendar year 1992. It contains citations and abstracts for Laboratory publications published in the quarter. Entries are arranged by technical topic and alphabetically by first author within each topic. Major topics include: Fundamental Electrical Measurements; Semiconductor Microelectronics; Signal Acquisition, Processing, and Transmission; Electrical Systems; Electromagnetic Interference. Following each abstract is the name and telephone number of the individual to contact for more information on the topic. The issue also includes a calendar of Laboratory conferences and workshops planned for calendar year 1992/1993 and a list of sponsors of the work. GRA

N93-24230# Department of the Navy, Washington, DC.
RADIO FREQUENCY CABLE TO OPTICAL FIBER CABLE Patent Application

Harold S. Rolls, inventor (to Navy) 29 Jun. 1992 11 p
(AD-D015620; US-Patent-Appl-SN-905703; Navy-Case-74457) Avail: CASI HC A03/MF A01

A bidirectional converter/interface for connecting several two-way broadband RF cables to a single pair of optical fibers is provided. In the reception mode, a broadband RF carrier of an optical conductor signal is directed to a plurality of bandpass filter/block converter combinations. These filter/converter combinations segment the broadband RF carrier into predetermined RF bands carrying the information. Each segmented band is then shifted (either up or down) to the receiving band frequency utilized by each of the RF systems. In the transmission mode, each transmitted signal from one of the RF systems is passed to a return path block converter/bandpass filter combination that shifts the entire transmitted band to a predetermined band. The predetermined bands are chosen such that each is a unique, non-overlapping band associated with a particular one of the RF systems. These unique bands are then combined into a single RF broadband signal that is converted to an optical signal and carried by a second optical conductor. GRA

N93-24291# Department of National Defence, Ottawa (Ontario). Air Research and Development Branch.
REVERSIBLE POTASSIUM VANADIUM BRONZE CATHODES (K(x)V6O(13+y)) WITH VARIOUS POTASSIUM TO VANADIUM RATIOS
E. Andrukaitis 1992 14 p
(CTN-93-60709) Avail: CASI HC A03/MF A01

Electrodes composed of crystalline K(x)V6O(13+y), where x is from 0 to 3.6 and y from 0 to 3.8, were prepared by thermal decomposition at 300-350 C of electrochemically deposited (NH4)(x)K(4-x)V6O16 phases. The reversible lithium insertion into these materials was measured under cyclic voltammetry and constant current conditions. Phase changes during discharge resembled those of V2O5 or V6O13 for similar vanadium oxidation states and small K/V ratios. The reversible capacity decreased as the K/V ratios increased from 0.1 to 0.5 and was poor above 0.5 (Li/V less than 0.1). The reversible capacity of the bronzes improved for lower O/V ratios and the discharge voltage was similar to non stoichiometric V6O13. Best cycle life was obtained for non stoichiometric vanadium oxides with K/V ratios in the range of 0.05 to 0.3 for O/V ratios between 2.4 and 2.5. Over 50 cycles at the C-rate were obtained (only 5-10 percent of the capacity lost at 0.4 e(-)/V depth of discharge). Author (CISTI)

N93-24295 Rutgers - The State Univ., New Brunswick, NJ.
THE EVALUATION OF HOLLOW DIELECTRIC WAVEGUIDES FOR THERMOMETRY AND SPECTROSCOPY Ph.D. Thesis
Steven John Saggese 1992 248 p
Avail: Univ. Microfilms Order No. DA9238482

Hollow waveguides have been primarily used for the delivery of 10.6 micron CO2 laser power for medical and industrial applications. One class of hollow waveguides transmits energy by attenuated total internal reflection in regions of the infrared (IR) where the wall material exhibits an index of refraction, n(sub wall), below that of the air core (n(sub air) approximately equal to 1). For certain materials the transmission window of the hollow guides can be large (ie. sapphire where n is less than 1 from 9.7-17.0 microns), therefore, these waveguides are also candidates for non-power applications. This study investigates new hollow waveguide materials, characterizes the attenuation of hollow waveguides propagating incoherent radiation, and evaluates their use in sensor applications. Bulk materials were evaluated by determining the infrared reflectivity (R) with a Fourier transform infrared analyzer (FTIR). The complex refractive index, calculated from the R data using Kramers-Kronig analysis, was then evaluated with the Marcatili and Schmeltzer hollow waveguide attenuation equation. Glass and crystalline materials were studied, and it was found that low silica content calcium aluminate glasses exhibit an n less than 1 at 10.6 microns. The predicted attenuation was strongly dependent upon the silica content, and a minimum loss of 0.45 dB/m at 10.6 microns for the HE(sub 11) mode was calculated for a CaO-Al2O3-BaO glass 1 mm i.d. hollow waveguide. The attenuation characteristics of vitreous silica and single-crystal sapphire hollow guides, accomplished with the FTIR, revealed that the attenuation is typically 10x higher than theoretical predictions and is strongly dependent upon the launch conditions and fiber geometry. The bending losses for the n(sub wall) less than 1 spectral regions were significantly lower then when n(sub wall) greater than 1. The temperature of the waveguide was found to shift the transmission window of the hollow guides, and this effect can be modelled using reflectivity analysis of the bulk wall material. Radiometric temperature measurements were conducted effectively from room temperature to 2000 C with the sapphire hollow waveguides. The exceptional range is due to the infrared transmission and high temperature stability of the sapphire. Sensitive, extended pathlength gas spectroscopy was demonstrated by flowing CH4 and CO2 within the core of the waveguides, and their attenuations and usable temperature range were found to surpass spectroscopic lightpipes. Dissert. Abstr.

N93-24302# Quad Design Technology, Inc., Camarillo, CA.
APPLICABILITY OF SUPERCONDUCTING INTERCONNECTION TECHNOLOGY FOR HIGH SPEED IC'S AND SYSTEMS Final Quarterly Report
Oct. 1992 210 p
(Contract N00014-90-C-0217)
(AD-A259520) Avail: CASI HC A10/MF A03

The extremely low-loss characteristics of HTSC interconnect renders it an attractive candidate for high density-high performance digital circuitry. The purpose of this program was to investigate these properties in detail, and to determine the characteristics of systems that can best exploit these properties. To this end a study was undertaken to more fully characterize the limitations of conventional interconnect, in particular in the context of source-terminated CMOS devices, a technology well-adapted to cryogenic applications. Thermal and mechanical considerations of HTSC-MCM technology were explored as well as part of this effort. Applying Rent's Rule to system connection requirements, it was determined that HTSC interconnects can significantly reduce the required levels of wiring and/or increase the packing density of conventionally partitioned IC's on an MCM. This advantage is amplified if IC's are first optimized for MCM application (eg. using larger numbers of area-I/O pads at the chip levels). Commercial applications of the technology were likewise explored, and it is believed that the development of conventional cryogenic-MCM optimization technology could prove to be a useful first step in the development of an appropriate HTSC-MCM infra-structure. GRA

N93-24312# Ohio State Univ., Columbus. Electroscience Lab.
JOINT SERVICES ELECTRONICS PROGRAM: APPENDIX Annual Report No. 15
Leon Peters, Jr. Nov. 1992 177 p
(Contract N00014-89-J-1007)
(AD-A259503; Rept-721563-5) Avail: CASI HC A09/MF A02

This Appendix contains the reprints published under JSEP in the time September 1991 to September 1992. In addition to the reprints contained herein, there are 7 papers already accepted for publication during the next contract period, 11 papers submitted and 11 papers in preparation. GRA

N93-24451# Allied-Signal Aerospace Co., Kansas City, MO. Kansas City Div.
INFRARED VACUUM SOLDERING PROCESS FOR THICK-FILM HYBRID MICROCIRCUITS
R. W. Brown Feb. 1993 24 p
(Contract DE-AC04-76DP-00613)
(DE93-007483; KCP-613-4983) Avail: CASI HC A03/MF A01

An infrared vacuum soldering (IVS) process was developed for thick-film hybrid microcircuits (HMC's) being manufactured at Allied-Signal Inc., Kansas City Division (KCD). Sample HMC's were assembled and destructively tested to determine the intermetallic growth of the thick-film metallization when soldered to a mounting plate using 50-indium/50-lead solder and 63-tin/37-lead solder. The large voids in a solder joint reduce the area of solder contact to the metallization and contribute to nonuniform stress across the substrate. The indium-rich areas that feed the intermetallic growth in the solder joint can cause the electrical ground of the microcircuit to fail when enough of the remaining gold is consumed, affecting the ceramic-to-gold adhesion properties. Vacuum soldering has reduced the voids to between 1 to 5 percent, as compared to 50 percent using the belt soldering process. The development of IVS has provided a process that is more efficient, safer, easier to maintain, and more economical to operate than CVS but which still restricts the amount of intermetallic growth and reduces the voids in the solder joint. The IVS process was characterized and released for production in January 1991. DOE

N93-24519# Oak Ridge National Lab., TN.
PRACTICAL SUPERCONDUCTOR DEVELOPMENT FOR ELECTRICAL POWER APPLICATIONS
Kenneth C. Goretta, comp. Oct. 1992 46 p
(Contract W-31-109-eng-38)
(DE93-007785; ANL-92/38) Avail: CASI HC A03/MF A01

Development of useful high-critical-temperature (high-Tc) superconductors requires synthesis of superconducting compounds; fabrication of wires, tapes, and films from these compounds; production of composite structures that incorporate stabilizers or insulators; and design and testing of efficient components. This report describes the technical progress of research and development efforts aimed at producing superconducting components that are based on the Y-Ba-Cu, Bi-Sr-Ca-Cu, Bi-Pb-Sr-Ca-Cu, and (Tl,Pb)-(Ba,Sr)-Ca-Cu oxide systems. Topics discussed are synthesis and heat treatment of high-(Tc) superconductors, formation of monolithic and composite wires and tapes, superconductor/metal connectors, characterization of structures and superconducting and mechanical properties, fabrication and properties of thin films, and development of prototype components. Collaborations with industry and academia are documented. DOE

N93-24611 Carleton Univ., Ottawa (Ontario). Dept. of Systems and Computer Engineering.
ADAPTIVE PREDISTORTION LINEARIZATION OF NONLINEAR POWER AMPLIFIERS M.S. Thesis
Bakri Aboukarr Ottawa, Ontario Carleton Univ. Sep. 1990 93 p
(ISBN-0-315-60483-2; CTN-93-60648) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

To prevent significant interference by users of the radio spectrum, stringent restrictions on spectral emission are applied, motivating users to seek highly efficient transmission schemes. Such spectrally efficient modulation schemes as quadradture phase shift keying (QPSK) easily suffer the nonlinearities of high power amplifiers (HPA) and tend to spread the spectrum of the filtered signal. Linearization of HPA is a way to preserve high dc-to-radio frequency power conversion efficiency while achieving a high degree of spectrum efficiency of the modulated signal. In an adaptive linearization technique, the low pass equivalent envelope of the modulated signal is predistorted such that the amplified signal is a linear version of the modulated signal. The predistortion is achieved by mapping the modulated signal to a distorted signal using table lookup functions. The mapping is done using the polar representation of the low pass complex envelope of the modulated signal. The adaptation technique is analyzed and tested on a QPSK modulation system using computer simulation. Results indicate that the technique provides excellent performance, and in addition has the advantages of implementation simplicity, low memory and processing requirements, and fast convergence. Author (CISTI)

N93-24612 Carleton Univ., Ottawa (Ontario). Dept. of Electronics.
HIGH-FREQUENCY BiCMOS TRANSCONDUCTANCE INTEGRATORS M.S. Thesis
R. Douglas Beards Ottawa, Ontario Carleton Univ. Oct. 1990 160 p
(ISBN-0-315-60484-0; CTN-93-60650) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, J8X 3X2, Canada, HC

The capabilities of a fine-line bipolar complementary metal oxide semiconductor (BiCMOS) process in the design of wideband transconductance integrators for precision monolithic continuous time filtering are explored. The design considerations of such an integrator are examined in detail, with an emphasis on tunability and phase compensation as a means for realizing a precision wideband design. The concept of open-loop transconductance filtering is described and possible circuit topologies are investigated. Detailed small-signal and large-signal analysis of one proposed circuit which has both tunable bandwidth and tunable phase compensation is presented. Application of such an integrator to open-loop transconductance filtering in the 10-50 MHz frequency range is studied. Simulation results show specific performance expectations of the proposed circuit. The tunable compensation circuit was seen to restrict the amplitude of signals which the integrator can pass without severe distortion or even instability occurring. A potential solution to this problem is deemed to be unsuitable for high frequency applications. The general design philosophy of applying low-frequency techniques to realize a high frequency circuit was seen to result in several fundamental problems. Author (CISTI)

N93-24614 Carleton Univ., Ottawa (Ontario). Dept. of Electronics.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF COINCIDENCES IN POISSON DISTRIBUTED PULSE TRAINS AND SPECTRAL DISTORTION CAUSED BY PULSE PILEUP Ph.D. Thesis
Quentin Bristow Ottawa, Ontario Carleton Univ. 27 Mar. 1990 259 p
(ISBN-0-315-60449-2; CTN-93-60652) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

The occurrence rates of pulse strings, or sequences of pulses with interarrival times less than the resolving time of the pulse-height analysis system used to acquire spectra, are derived from theoretical considerations. Logic circuits were devised to make experimental measurements of multiple pulse string occurrence rates in the output from a scintillation detector over a wide range of count rates. Markov process theory was used to predict state transition rates in the logic circuits, enabling the experimental data to be checked rigorously for conformity with those predicted for a Poisson distribution. No fundamental discrepancies were observed. Monte Carlo simulations, incorporating criteria for pulse pileup inherent in the operation of modern analog to digital converters, were used to generate pileup spectra due to coincidences between two pulses (first order pileup) and three pulses (second order pileup) for different semi-Gaussian pulse shapes. Coincidences between pulses in a single channel produced a basic probability density function spectrum. The use of a flat spectrum showed the first order pileup distorted the spectrum to a linear ramp with a pileup tail. A correction algorithm was successfully applied to correct entire spectra (simulated and real) for first and second order pileups. Author (CISTI)

N93-24616 Carleton Univ., Ottawa (Ontario). Dept. of Electronics.
FREQUENCY STABILITY CHARACTERIZATION OF HOPPING SOURCES AND MICROPROCESSOR-CONTROLLED FREQUENCY SYNTHESIS Ph.D. Thesis
Grigorius A. Kalivas Ottawa, Ontario Carleton Univ. May 1990 240 p
(ISBN-0-315-60447-6; CTN-93-60653) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

A study is presented of the time domain stability of frequency agile sources such as voltage controlled oscillators under frequency hopping conditions. A procedure leading to short term noise characterization is presented, followed by a novel approach for obtaining expresssions for stability measures. This general approach can treat all types of noise in the same way, without requiring any knowledge of the autocorrelation function of the phase noise. As an application of the stability measurement procedure, a frequency synthesis method incorporating these ideas is included. The corresponding test system embodies recent trends toward computer control and digital processing in frequency synthesis. The synthesizer is operated in a closed-loop mode in which a frequency counter detects departures of the frequency from the desired value and correction is computer controlled using time domain adaptive algorithms including a novel modified least mean square algorithm exhibiting fast convergence. Experiment shows that regardless of the number of frequencies or the frequency hopping pattern, there always exists a flat horizontal portion on the Barnes-Allan variance estimator curves for values of averaging intervals in the 100 microsecond region. The implemented algorithm was shown to work as theoretically expected. Author (CISTI)

N93-24617 Carleton Univ., Ottawa (Ontario). Dept. of Electronics.
A WIDEBAND PARALLEL SAMPLING SYSTEM M.S. Thesis
Paul Langner Ottawa, Ontario Carleton Univ. Mar. 1990 237 p
(ISBN-0-315-60463-8; CTN-93-60654) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

The operational bandwidth of contemporary flash analog to digital converters (ADC) is limited by the response time of the comparator. The difficulties in incorporating a fast track and hold amplifier into the front end of an ADC also limit performance. To overcome this limitation, it is possible to operate several ADC's in parallel. The theory and design of a parallel

sampled data system are presented, including the equivalence of single-point and parallel sampling systems. A prototype system is constructed for use with 100 MHz, 4-bit ADC's. A 1.2 Giga-sample/second system was made so that the input could be equipped with a realizable anti-aliasing filter. A numerical analysis of the overall system is developed and a program is presented which incorporates this analysis. This program is also used to demonstrate the spectral degradation that arises from errors in the parallel sampling system. In addition, a bipolar impulse generator used in the system is described. The practical results obtained from the prototype are compared with theory, showing good agreement. Author (CISTI)

N93-24625# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
ANALYTICAL RESULTS FOR THE ELECTROMAGNETIC RESPONSE OF A COMPOSITE SUPERCONDUCTING WIRE IN PARALLEL FIELDS
E. M. J. Niessen and P. J. Zandbergen May 1992 42 p
(MEMO-1059; ETN-93-93196) Avail: CASI HC A03/MF A01

An analytical method for calculating the electromagnetic response of a composite superconducting wire in fields parallel to the wire axis is presented. In general, the basic elements of a description are the Maxwell equations supplemented with a set of constitutive equations relating the electric field vector E and the current density vector j in the composite. The problem is nonlinear due to the nonlinear (vector E) - (vector j) relation describing the supercomputing filaments. By analytical means, it is shown that the nonlinear behavior of this kind of supercomputers can be studied. The new analytical method completely takes these nonlinear effects into account, contrary to linear methods which remove the nonlinear effects by introducing a linear surface current. The method gives an exact description of the response of a wire with non-conducting matrix material surrounding the filaments in the limit for zero filament radius. For a composite wire it provides a very good approximation, neglecting transient effects and the normal currents compared to the supercomputing currents. Results obtained by the method and a linear method are compared with data from a numerical method taking all effects into account. The linear method fails to decribe typical nonlinear effects. The new method shows very good agreement with numerical results. It provides data even more accurate than numerical data in regimes which suffer from relative large discretization errors. ESA

N93-22178*# Harris Corp., Palm Bay, FL.
FLEXIBLE HIGH SPEED CODEC
James V. Wernlund *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 281-288 (For primary document see N93-22149 08-99)
(Contract NAS3-25087)
Avail: CASI HC A02/MF A04

N93-22179*# Army Research Lab., Fort Monmouth, NJ.
ULTRA-STABLE, LOW PHASE NOISE DIELECTRIC RESONATOR STABILIZED OSCILLATORS FOR MILITARY AND COMMERCIAL SYSTEMS
Muhammad Mizan, Thomas Higgins, and Dana Sturzebecher *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 289-295 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22200*# Axiomatics Corp., Woburn, MA.
ON-LINE PROCESS ANALYSIS INNOVATION: DICOMP (TM) SHUNTING DIELECTRIC SENSOR TECHNOLOGY
Craig R. Davis and Frank A. Waldman *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 477-484 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N93-22071# Maryland Univ., College Park. Dept. of Mechanical Engineering.
EXPERIMENTAL AND NUMERICAL INVESTIGATION OF PASSIVE SCALAR DISPERSAL IN BOUNDED TURBULENT SHEAR FLOWS
J. M. Wallace, P. S. Bernard, J. L. Balint, and L. Ong 1992 9 p Presented at the 10th Symposium on Energy Engineering Sciences: Synergism of Analysis, Modeling, and Experiment, Argonne, IL, 11-13 May 1992
(Contract DE-FG05-88ER-13838)
(DE93-004122; CONF-9205147-3) Avail: CASI HC A02/MF A01

Laboratory experiments and direct numerical simulations (DNS) of passive scalar contaminant dispersal in bounded shear flows have been carried out. Both mass and heat transport have been experimentally studied. Statistical results for the temperature plume which develops from a line heat source at the wall are compared to the DNS results. The DNS results for this case and for the case of a uniform source with constant temperature boundaries are also compared to various model predictions. DOE

N93-22331# Sandia National Labs., Albuquerque, NM.
ADAPTIVE MESHING IN SOLIDS
J. D. Chieslar (RE/SPEC, Inc., Rapid City, SD.) 28 Oct. 1992 4 p Presented at the Joint Army-Navy-Air Force Structures and Mechanical Behavior Subcommittee Meeting, Albuquerque, NM, 16-19 Nov. 1992
(Contract DE-AC04-76DP-00789)
(DE93-003238; SAND-92-7330C; CONF-9211125-1) Avail: CASI HC A01/MF A01

Iron's frontal solution method is employed in a recursive fashion to support adaptive meshing for solids. Specifically, the frontal solution environment is encapsulated into a data structure enabling it to be conveniently exchanged at different levels of recursion. Additionally, the ability to handle Lagrange multipliers added to the solver. The resulting finite element technique, while being relatively easy to implement, addresses many issues of adaptive meshing which are peculiar to nonlinear solids. DOE

N93-22401*# Case Western Reserve Univ., Cleveland, OH.
GENERATION OF MONODISPERSE DROPLETS BY SPONTANEOUS CONDENSATION OF FLOW IN NOZZLES Final Technical Report
Der-Shaiun Lai and J. R. Kadambi Jan. 1993 188 p
(Grant NAG3-831)
(NASA-CR-192356; NAS 1.26:192356) Avail: CASI HC A09/MF A02

Submicron size monodisperse particles are of interest in many industrial and scientific applications. These include the manufacture of ceramic parts using fine ceramic particles, the production of thin films by deposition of ionized clusters, monodisperse seed particles for laser anemometry, and the study of size dependence of cluster chemical and physical properties. An inexpensive and relatively easy way to generate such particles is by utilizing the phenomenon of spontaneous condensation. The phenomenon occurs when the vapor or a mixture of a vapor and a noncondensing gas is expanded at a high expansion rate. The saturation line is crossed with the supercooled vapor behaving like a gas, until all of a sudden at the so called Wilson point, condensation occurs, resulting in a large number of relatively monodisperse droplets. The droplet size is a function of the expansion rate, inlet conditions, mass fraction of vapor, gas properties, etc. Spontaneous condensation of steam and water vapor and air mixture in a one dimensional nozzle was modeled and the resulting equations solved numerically. The droplet size distribution at the exit of various one dimensional nozzles and the flow characteristics such as pressure ratio, mean droplet radius, vapor and droplet temperatures, nucleation flux, supercooling, wetness, etc., along the axial distance were obtained. The numerical results compared very well with the available experimental data. The effect of inlet conditions, nozzle expansion rates, and vapor mass

fractions on droplet mean radius, droplet size distribution, and pressure ratio were examined. Author (revised)

N93-22456# National Research Council of Canada, Ottawa (Ontario). Transportation Technology Program.

COMPUTATIONAL FLUID DYNAMICS: RESEARCH ACTIVITIES AND SERVICES AT NRC

Sep. 1992 13 p Original contains color illustrations

(NRC-TTP-02-92; NRC-32441; CTN-93-60701) Avail: CASI HC A03/MF A01

An overview is presented of research activities and services available to outside clients in the field of computational fluid dynamics within the Transportation Technology Program at Canada's National Research Council. Research objectives, current activities, numerical tools and hardware available, and contacts for further inquiries are given for computational fluid dynamics research in the following laboratories or program divisions at the Council: Coastal Zone Engineering Program Hydraulics Laboratory; Building Performance Laboratory; Numerical Wave Tank Program; Ship Dynamics Simulation Program; Combustion and Fluids Engineering Program; Arctic Vessel Research Laboratory; Institute for Aerospace Research High Speed and Applied Aerodynamics Laboratories; Cold Regions Engineering Program; and Industrial Materials Institute Computer Integrated Materials Processing activities. CISTI

N93-22509# Ames Lab., IA.

PROPAGATION OF ELASTIC WAVES THROUGH INHOMOGENEOUS, ANISOTROPIC MATERIALS Ph.D. Thesis

A. Minachi 25 Nov. 1992 177 p

(Contract W-7405-eng-82)

(DE93-006247; IS-T-1581) Avail: CASI HC A09/MF A02

Ultrasonic nondestructive inspection demands more precise knowledge of sound propagation in materials. An approximate Gauss-Hermite (GM) model was developed a few years ago for the ultrasonic fields radiated into isotropic and anisotropic materials. In this dissertation, the validity of the GM model in a multilayered medium is evaluated. First, a method of finding the elastic constants of anisotropics is given. Comparisons between GM predictions and finite element predictions show good agreement around the central ray direction, but due to Fresnel approximation, the accuracy of GM model degrades away from the forward propagation direction. The GM model was used for sizing delaminations in a multilayered composite structure. This method, utilizing the reflected signal from the delamination, showed considerable improvement over the traditional sizing method. The model, with local ray tracing, was also used to predict the ultrasonic field beyond an irregularly shaped interface (step discontinuity), with good agreement with experiment. DOE

N93-22521# Naval Research Lab., Washington, DC.

TESTS OF RANDOM FLIGHT AND CLOSURE MODELS IN PREDICTING TURBULENT SCALAR TRANSPORT

R. A. Handler, A. L. Rovelstad, and Peter S. Bernard (Maryland Univ., College Park.) Jan. 1993 5 p Presented at the PACAM 3, Sao Paolo, Brazil, Jan. 1993

(Contract DE-FG05-88ER-13838)

(DE93-004123; CONF-930155-1) Avail: CASI HC A01/MF A01

The dispersal of contaminants in turbulent shear flows is an important concern in environmental science, meteorology and industrial processes. A number of approaches have been pursued in developing accurate means of predicting these phenomena, including traditional closure models applied to the Reynolds averaged transport equations, random flight models and probability density Junction methods. The development of DNS techniques for simulating turbulent dispersion provides a controlled means for studying the relative merits of diffusion algorithms in settings where all of the necessary fluid mechanical properties needed to implement the diffusion-calculations are available. The objective of this work is to describe a number of such tests which have been performed for turbulent dispersion in channel flow due to uniform and line sources. DOE

N93-22596*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

STRUCTURE OF CONFINED LAMINAR SPRAY DIFFUSION FLAMES: NUMERICAL INVESTIGATION

M. A. Mawid, D. L. Bulzan, and S. K. Aggarwal (Illinois Univ., Chicago.) Feb. 1993 29 p

(RTOP 505-62-21)

(NASA-TM-106038; ICOMP-93-2; E-7193; NAS 1.15:106038) Avail: CASI HC A03/MF A01

The structure of confined laminar spray diffusion flames is investigated numerically by solving the gas-phase conservation equations for mass species, continuity, momentum, and energy and the liquid-phase equations for droplet position, velocity, size, and temperature. A one-step global reaction scheme along with six equilibrium reactions are employed to model the flame chemistry. Monodisperse as well as polydisperse sprays are considered. The numerical results demonstrate that liquid spray flames substantially differ from gaseous flames in their structure, i.e., temperature, concentration, and velocity fields, shape, and dimensions under the same conditions. Spray flames are predicted to be taller and narrower than their counterpart gaseous ones and their shapes are almost cylindrical. This is in agreement with experimental observations. The numerical computations also show that the use of the equilibrium reactions with the one-step reaction scheme decreases the flame temperature compared to the one-step reaction scheme without the equilibrium reactions and more importantly increases the surface area of the flame zone due to a phenomenon termed 'equilibrium broadening.' The spray flames also possess a finite thickness with minimal overlap of the fuel and oxygen species. A case for which a fuel-mixture consisting of 20 to 80 percent gas-liquid by mass is introduced into the combustor is also investigated and compared with predictions using only gaseous or liquid fuel. Author (revised)

N93-22604*# California Univ., Davis. Dept. of Mechanical Engineering.

NAVIER-STOKES COMPUTATION OF COMPRESSIBLE TURBULENT FLOWS WITH A SECOND ORDER CLOSURE, PART 1 Final Report

Hieu Haminh (Centre National de la Recherche Scientifique, Toulouse, France.), Wolfgang Kollmann (Centre National de la Recherche Scientifique, Toulouse, France.), and Dany Vandromme (Centre National de la Recherche Scientifique, Mont-Saint-Aignan, France.) 1990 69 p

(Contract NCC2-186)

(NASA-CR-192287; NAS 1.26:192287) Avail: CASI HC A04/MF A01

A second order closure turbulence model for compressible flows is developed and implemented in a 2D Reynolds-averaged Navier-Stokes solver. From the beginning where a kappa-epsilon turbulence model was implemented in the bidiagonal implicit method of MACCORMACK (referred to as the MAC3 code) to the final stage of implementing a full second order closure in the efficient line Gauss-Seidel algorithm, numerous work was done, individually and collectively. Besides the collaboration itself, the final product of this work is a second order closure derived from the Launder, Reece, and Rodi model to account for near wall effects, which has been called FRAME model, which stands for FRench-AMerican-Effort. During the reporting period, two different problems were worked out. The first was to provide Ames researchers with a reliable compressible boundary layer code including a wide collection of turbulence models for quick testing of new terms, both in two equations and in second order closure (LRR and FRAME). The second topic was to complete the implementation of the FRAME model in the MAC5 code. The work related to these two different contributions is reported. dilatation in presence of stron shocks. This work, which has been conducted during a work at the Center for Turbulence Research with Zeman aimed also to cros-check earlier assumptions by Rubesin and Vandromme. Derived from text

N93-22677# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.

RESPONSE OF A NON-VISCOUS LIQUID COLUMN WITH ANCHORED LIQUID SURFACE TO AXIAL EXCITATION

Helmut F. Bauer 1991 27 p

(LRT-WE-9-FB-4-1991; ETN-93-93400) Avail: CASI HC A03/MF A01

The response of an axially excited cylindrical liquid column consisting of frictionless and incompressible liquid was investigated for a harmonic excitation. The column is located between two discs such that the free liquid surface exhibits there a stuck edge boundary condition. Free surface displacement and velocity response were determined. In addition the transient behavior of the liquid by the change of the axial excitation from one excitation amplitude and forcing frequency to another one was studied. The results shall be used for the efficient planning of the 'LICORE' experiments in the second German Spacelab mission (D-2). ESA

N93-22678# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.

MARANGONI CONVECTION IN A SPINNING LIQUID COLUMN

Helmut F. Bauer and U. Strasser 1991 104 p

(LRT-WE-9-FB-13-1991; ETN-93-93401) Avail: CASI HC A06/MF A02

Under the action of an axial temperature gradient, a thermocapillary convection arises in a spinning liquid bridge. The thermocapillary convection was treated for constant but different temperature at the upper and lower disc wall and also for a directly imposed temperature distribution at the free liquid surface. The streamfunction and circulation were obtained, from which the velocity distribution could be obtained. ESA

N93-22694# Argonne National Lab., IL.

COMMIX-1AR/P: A THREE-DIMENSIONAL TRANSIENT SINGLE-PHASE COMPUTER PROGRAM FOR THERMAL HYDRAULIC ANALYSIS OF SINGLE AND MULTICOMPONENT SYSTEMS

P. L. Garner, R. N. Blomquist, and E. M. Gelbard Sep. 1992 560 p

(Contract W-31-109-eng-38)

(DE93-006044; ANL-92/33) Avail: CASI HC A24/MF A04

The COMMIX-1AR/P computer program is designed for analyzing the steady-state and transient aspects of single-phase fluid flow and heat transfer in three spatial dimensions. This version is an extension of the modeling in COMMIX-1A to include multiple fluids in physically separate regions of the computational domain, modeling descriptions for pumps, radiation heat transfer between surfaces of the solids which are embedded in or surround the fluid, a k-(var lepsilon) model for fluid turbulence, and improved numerical techniques. The porous-medium formulation in COMMIX allows the program to be applied to a wide range of problems involving both simple and complex geometrical arrangements. The input preparation and execution procedures are presented for the COMMIX-1AR/P program and several postprocessor programs which produce graphical displays of the calculated results. DOE

N93-22734# Arizona Univ., Tucson. Dept. of Aerospace and Nuclear Engineering.

NUMERICAL SIMULATIONS OF THE CONTROL OF WAVE PACKET DISTURBANCES IN THE BOUNDARY LAYER ON A FLAT PLATE Final Report

Peter A. Dittrich and Hermann F. Fasel 12 Nov. 1992 151 p

(Contract N00014-90-J-1274)

(AD-A259923) Avail: CASI HC A08/MF A02

The control of laminar turbulent transition in incompressible flat plate boundary layers is investigated using direct numerical simulations. The investigations focus in particular on the control of wave packet disturbances that are characteristic for natural transition. A fully implicit finite difference/spectral method was developed to solve the governing equations. Wave packet disturbances are created by simulating the effect of thermally activated heater elements on the plate surface. Through controlled spanwise variation of the temperature of the heater elements, both two- and three-dimensional wave packet disturbances could be investigated. A transfer function technique was developed for the control strategy, where the transfer function is obtained directly from the numerical simulations. With this technique low amplitude, two-dimensional wave packet disturbances could be almost completely cancelled. Using a modified transfer function technique the control of three-dimensional wave packets was also very successful. It was found that the attenuation of only the two-dimensional components of a three-dimensional wave packet considerably delays the onset of the nonlinear interactions of the oblique modes. GRA

N93-22757# Argonne National Lab., Idaho Falls, ID. Materials and Components Technology Div.

THEORETICAL AND PRAGMATIC MODELLING OF GOVERNING EQUATIONS FOR A TWO-PHASE FLOW IN BUBBLY AND ANNULAR FLOW REGIMES

M. Bottoni and W. Sengpiel (Kernforschungszentrum G.m.b.H., Karlsruhe, Germany.) 1992 8 p Presented at the 4th Brazilian Thermal Science Meeting (ENCIT-92), Rio de Janeiro, Brazil, 1-4 Dec. 1992

(Contract W-31-109-eng-38)

(DE93-004200; ANL/MCT/CP-77705; CONF-921234-1) Avail: CASI HC A02/MF A01

Starting from the rigorous formulation of the conservation equations for mass, momentum, and enthalpy, derived for a two-phase flow by volume averaging microscopic balance equations over Eulerian control cells, the formulation of the terms describing exchanges between the phases are discussed. Two flow regimes are taken into consideration, bubbly flow, applicable for small or medium void fractions, and annular flow, for large void fractions. When lack of knowledge of volume-averaged physical quantities make the rigorously formulated terms useless for computational purposes, modeling of these terms is discussed. DOE

N93-22809*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

IMPROVED TWO-EQUATION K-OMEGA TURBULENCE MODELS FOR AERODYNAMIC FLOWS

Florian R. Menter Oct. 1992 34 p

(RTOP 505-59-40)

(NASA-TM-103975; A-92183; NAS 1.15:103975) Avail: CASI HC A03/MF A01

Two new versions of the k-omega two-equation turbulence model will be presented. The new Baseline (BSL) model is designed to give results similar to those of the original k-omega model of Wilcox, but without its strong dependency on arbitrary freestream values. The BSL model is identical to the Wilcox model in the inner 50 percent of the boundary-layer but changes gradually to the high Reynolds number Jones-Launder k-epsilon model (in a k-omega formulation) towards the boundary-layer edge. The new model is also virtually identical to the Jones-Lauder model for free shear layers. The second version of the model is called Shear-Stress Transport (SST) model. It is based on the BSL model, but has the additional ability to account for the transport of the principal shear stress in adverse pressure gradient boundary-layers. The model is based on Bradshaw's assumption that the principal shear stress is proportional to the turbulent kinetic energy, which is introduced into the definition of the eddy-viscosity. Both models are tested for a large number of different flowfields. The results of the BSL model are similar to those of the original k-omega model, but without the undesirable freestream dependency. The predictions of the SST model are also independent of the freestream values and show excellent agreement with experimental data for adverse pressure gradient boundary-layer flows. Author

N93-22811*# Institute for Computer Applications in Science and Engineering, Hampton, VA.

ON THE NONLINEAR INTERFACIAL INSTABILITY OF ROTATING CORE-ANNULAR FLOW Final Report

Aidrian V. Coward (Manchester Univ., England.) and Philip Hall (Manchester Univ., England.) Washington Feb. 1993 40 p Submitted for publication

(Contracts NAS1-18605; NAS1-19480; RTOP 505-90-52-01)

(NASA-CR-191432; NAS 1.26:191432; ICASE-93-7) Avail: CASI HC A03/MF A01

The interfacial stability of rotating core-annular flows is investigated. The linear and nonlinear effects are considered for the case when the annular region is very thin. Both asymptotic and numerical methods are used to solve the flow in the core and film regions which are coupled by a difference in viscosity and density. The long-term behavior of the fluid-fluid interface is determined by deriving its nonlinear evolution in the form of a modified Kuramoto-Sivashinsky equation. We obtain a generaiization of this equation to three dimensions. The flows considered are applicable to a wide array of physical problems where liquid films are used to lubricate higher or lower viscosity core fluids, for which a concentric arrangement is desired. Linearized solutions show that the effects of density and viscosity stratification are crucial to the stability of the interface. Rotation generally destabilizes non-axisymmetric disturbances to the interface, whereas the centripetal forces tend to stabilize flows in which the film contains the heavier fluid. Nonlinear affects allow finite amplitude helically travelling waves to exist when the fluids have different viscosities. Author

N93-22817*# Queensland Univ., Saint Lucia (Australia). Dept. of Mechanical Engineering.

SHOCK TUNNEL STUDIES OF SCRAMJET PHENOMENA, SUPPLEMENT 6

M. Wendt, M. Nettleton, R. G. Morgan, K. Skinner, R. Casey, R. Stalker, C. Brescianini, A. Paull, G. Allen, and M. Smart et al Feb. 1993 230 p

(Grant NAGw-674; RTOP 505-70-62-02)

(NASA-CR-191428; NAS 1.26:191428) Avail: CASI HC A11/MF A03

Reports by the staff of the University of Queensland on various research studies related to the advancement of scramjet technology are presented. These reports document the tests conducted in the reflected shock tunnel T4 and supporting research facilities that have been used to study the injection, mixing, and combustion of hydrogen fuel in generic scramjets at flow conditions typical of hypersonic flight. In addition, topics include the development of instrumentation and measurement technology, such as combustor wall shear and stream composition in pulse facilities, and numerical studies and analyses of the scramjet combustor process and the test facility operation. Author

N93-22867# Argonne National Lab., IL.
AUTOMATIC DIFFERENTIATION OF ADVANCED CFD CODES FOR MULTIDISCIPLINARY DESIGN
C. Bischof, G. Corliss, A. Griewank, L. Green, K. Haigler, and P. Newman 1992 17 p Presented at the Symposium on High-performance Computing for Flight Vehicles, Arlington, VA, 7-9 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-005685; ANL/MCS/CP-78197; CONF-921243-1) Avail: CASI HC A03/MF A01

Automated multidisciplinary design of aircraft and other flight vehicles requires the optimization of complex performance objectives with respect to a number of design parameters and constraints. The effect of these independent design variables on the system performance criteria can be quantified in terms of sensitivity derivatives which must be calculated and propagated by the individual discipline simulation codes. Typical advanced CFD analysis codes do not provide such derivatives as part of a flow solution; these derivatives are very expensive to obtain by divided (finite) differences from perturbed solutions. It is shown that sensitivity derivatives can be obtained accurately and efficiently using the ADIFOR source translator for automatic differentiation. In particular, it is demonstrated that the 3-D, thin-layer Navier-Stokes, multigrid flow solver called TLNS3D is amenable to automatic differentiation in the forward mode even with its implicit iterative solution algorithm and complex turbulence modeling. It is significant that by using computational differentiation, consistent discrete nongeometric sensitivity derivatives have been obtained from an aerodynamic 3-D CFD code in a relatively short time, e.g., O(man-week) not O(man-year). DOE

N93-22886# Sandia National Labs., Albuquerque, NM.
FINITE ELEMENT METHODS IN HEAT TRANSFER
D. K. Gartling Oct. 1992 172 p
(Contract DE-AC04-76DP-00789)
(DE93-006451; SAND-92-0885) Avail: CASI HC A08/MF A02

The application of the finite element method to problems in conduction and convection heat transfer is described. The formulation of the basic equations is presented for nonisothermal, incompressible, viscous flows and nonisothermal flows in porous media; typical solution algorithms for both transient and time-independent problems are described. Example analyses are included for problems in heat conduction, forced convection and free convection. DOE

N93-22897# National Inst. of Standards and Technology, Gaithersburg, MD. Applied and Computational Mathematics Div.
ASYMPTOTIC BEHAVIOR OF MODULATED TAYLOR-COUETTE FLOWS WITH A CRYSTALLINE INNER CYLINDER
R. J. Braun, G. B. McFadden, B. T. Murray, S. R. Coriell, and M. E. Glicksman Nov. 1992 47 p Prepared in cooperation with Rensselaer Polytechnic Inst., Troy, NY
(PB93-139061; NISTIR-4971) Avail: CASI HC A03/MF A01

The authors consider the linear stability of a modulated Taylor-Couette system when the inner cylindrical boundary consists of a crystalline solid-liquid interface. Both experimentally and in numerical calculations it is found that the two-phase system is significantly less stable than the analogous rigid-walled system for materials with moderately large Prandtl numbers. A numerical treatment based on Floquet theory is described, which gives results that are in good agreement with preliminary experimental findings. In addition, the instability is further examined by carrying out a formal asymptotic expansion of the solution in the limit of large Pradtl number. In the limit the Floquet analysis is considerably simplified, and the linear stability of the modulated system can be determined to leading order through a conventional stability analysis, without recourse to Floquet theory. The resulting simplified problem is then studied for both the narrow gap geometry and for the case of a finite gap. It is surprising that the determination of the linear stability of a two-phase system is considerably simpler than that of the rigid walled system, despite the complications introduced by the presence of the crystal-melt interface. Derived from text

N93-22932# Pennsylvania State Univ., University Park.
SURFACE ACOUSTIC WAVE SENSORS AND PIEZOELECTRIC ACTUATORS FOR INVESTIGATIONS OF TRANSITIONAL AND TURBULENT FLOWS Final Technical Report
Vasundara V. Varadan, Wayne R. Pauley, and Vijay K. Varadan May 1992 37 p
(Contract N00014-89-J-3102)
(AD-A260482) Avail: CASI HC A03/MF A01

A dual SAW sensor attached in cantilever fashion to a free floating membrane flush mounted on a structure exposed to turbulent fluid flow are described. Shear stress on the membrane due to the flow conditions deforms and bends the cantilever beam. The SAW devices are mounted such that one device is in compression and the other in tension. The cantilever arrangement magnifies the deformation of the SAW sensors by many orders of magnitude relative to the membrane. The SAW devices are attached to oscillator circuits and the change in frequency of the SAW oscillators due to the deformation can be accurately measured. The dual arrangement compensates changes in temperatures, electrical and mechanical noise and other changes and the difference in frequency measured by a mixer is directly related to the shear stress on the structure. Experiments conducted in a wind tunnel are described. GRA

N93-23059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SUMMARY OF EXPERIMENTAL HEAT-TRANSFER RESULTS FROM THE TURBINE HOT SECTION FACILITY
Herbert J. Gladden and Fredrick C. Yeh Apr. 1993 216 p
(RTOP 505-62-52)
(NASA-TP-3250; E-6615; NAS 1.60:3250) Avail: CASI HC A10/MF A03

Experimental data from the turbine Hot Section Facility are presented and discussed. These data include full-coverage film-cooled airfoil results as well as special instrumentation results obtained at simulated real engine conditions. Local measurements of airfoil wall temperature, airfoil gas-path static-pressure distribution, and local heat-transfer coefficient distributions are presented and discussed. In addition, measured gas and coolant temperatures and pressures are presented. These data are also compared with analyses from Euler and boundary-layer codes. Author

N93-23110 Mississippi State Univ., State College.
INCOMPRESSIBLE NAVIER-STOKES ALGORITHM FOR FLOW AND HEAT TRANSFER OVER ROUGH SURFACES Ph.D. Thesis
Kenton Ridgeway Fleming 1992 110 p
Avail: Univ. Microfilms Order No. DA9237050

The development of a computer model for simulation of incompressible turbulent flow and heat transfer over rough surfaces using the discrete element method is presented. The discrete element roughness model is implemented into an existing incompressible Navier-Stokes algorithm. This algorithm is a finite volume, incompressible Navier-Stokes solver which uses artificial compressibility and the Roe approximate Riemann solver, also referred to as the flux difference split method. The equations solved in this code were modified to include surface roughness effects in the flow. Details of the roughness effects on the flow are modeled empirically instead of being resolved in the computational geometry. The roughness element from drag and heat transfer are treated as volumetric sink and source terms, respectively. Cases were treated for flow and convective heat transfer over smooth and rough flat plates with different free stream velocities and roughness distributions. Also, flow computations were performed for an axisymmetric body with an inflected curved stern and a NACA-0012 airfoil. The rough flow prediction model was observed to simulate the effects of surface roughness accurately; in one case flow separation was indicated. In all cases the computed effects of surface roughness were observed to yield higher skin friction than the equivalent flow over a smooth surface. For the case of computed heat transfer over the flat plate, roughness increased heat transfer. Dissert. Abstr.

N93-23177 Alberta Univ., Edmonton.
EXPERIMENTAL INVESTIGATION OF DEVELOPING AND FULLY DEVELOPED FLOW IN A CURVED DUCT OF SQUARE CROSS SECTION Ph.D. Thesis
Barry M. Bara 1991 261 p
(ISBN-0-315-70029-7) Avail: Univ. Microfilms Order No. DANN70029

An experimental and numerical study investigating the flow development and fully developed flows of an incompressible Newtonian fluid in a curved duct of square cross section for a curvature ratio of 15.1 is presented. Numerical simulations of flow development were performed using a parabolized form of the steady three-dimensional Navier-Stokes equations without imposing numerical symmetry. In addition, the two-dimensional solution structure was calculated using a steady formulation of the governing equations with a symmetry condition applied at the horizontal duct centerline. Both the three-dimensional and two-dimensional computer codes used in this study had been developed by previous investigators. Laser doppler measurements of axial velocity and flow visualization at Dn = 125, 137 and 150, revealed a steady and symmetric two-vortex flow at Dn = 125, and a steady and symmetric four-vortex flow at both Dn = 137 and Dn = 150 (Dn = Re/(square root of R/a) where Re is the Reynolds number, R is the radius of curvature of the duct and a is the width of the duct). Axial velocity measurements showed that the four-vortex flow at Dn = 150 developed to the solution predicted by the two-dimensional numerical simulation. However, the four-vortex flow at Dn = 137 was still developing when the flow had reached the end of the 240 deg axial length of the duct. A numerical investigation for Dean numbers below Dn = 175 revealed that at the limit point of the two-cell to four-cell transition the development length appeared to be infinite and thereafter decreased for increasing Dean numbers. The behavior of decreasing development length of the four-vortex flow with increasing Dean number has not been reported previously. Using a symmetrically positioned pin at theta = 5 deg to induce the four-cell flows, the two-dimensional solution structure for Dn less than or equal to 150 was experimentally observed for the first time. Experiments confirmed the numerical prediction that four-vortex flows are stable to symmetric perturbations, but unstable to asymmetric perturbations. An experimental and numerical investigation suggested that the four-vortex flow might evolve to flows with sustained spatial oscillations farther downstream. However without sufficient axial length to experimentally verify this, the state of the four-vortex flow at large axial distances still remains an unknown. Dissert. Abstr.

N93-23178 Ohio State Univ., Columbus.
ON THE SOLUTION OF FLUID FLOW AND SOLID DEFORMATION INTERACTION PROBLEMS Ph.D. Thesis
Narayana Behera 1992 140 p
Avail: Univ. Microfilms Order No. DA9238129

The objective of this research is to develop numerical methods to solve the coupled field equations of fluid and solid mechanics which arise due to the interaction of fluid flow and solid deformation. Computational methods have been developed for solving a general class of time-dependent incompressible flow problems with solid boundaries that deform under the transient pressure and viscous stresses from the fluid. Three example problems are considered in this work. The first one is a limiting case of fluid solid interaction where the solid is just an elastic membrane enclosing the fluid. A physical counterpart of this is flow involving surface tension. Oscillation of a liquid jet issuing out of an elliptical orifice is chosen as the example problem for this case. The results of solving the Navier-Stokes equations are used to verify the validity of a simplified theoretical model for this physical problem. Two distinct numerical methods are used to solve the N-S equations involving moving boundary conditions. Finite difference method and spectral element methods are used. Both spatial and temporal coordinate transformation is used for the FD formulation of the problem. A Poisson equation for pressure is solved, and hyperbolic-parabolic grid generation is done at each time step. A spectral element method solution to the oscillating jet problem has been obtained. FD solution shows more damping compared to the SEM solution and the solution from the theoretical model, but the period of oscillation of all the three methods agree very closely. The solutions have been numerically validated. The second example problem of fluid flow and solid deformation interaction is the Couette flow with an elastic slab as boundary. A solution method has been demonstrated in which the algebraic equations resulting from the discretization of the fluid and solid equations can be solved separately and still have the solution to the coupled problem. This finding makes the solution of the coupled field equations in higher dimensions more easily implementable on conventional as well as parallel computers. Flow around an elastic cylinder is computed with this methodology, and the results compared with the flow around rigid cylinders. Dissert. Abstr.

N93-23180 Washington Univ., Seattle.
LAMINAR AND TURBULENT INCOMPRESSIBLE FLUID FLOW ANALYSIS WITH HEAT TRANSFER BY THE FINITE ELEMENT METHOD Ph.D. Thesis
Robert James Cochran 1992 315 p
Avail: Univ. Microfilms Order No. DA9239435

A study of the finite element method applied to two-dimensional incompressible fluid flow analysis with heat transfer is performed using a mixed Galerkin finite element method with the primitive variable form of the model equations. Four biquadratic, quadrilateral elements are compared in this study--the serendipity biquadratic element with bilinear continuous pressure interpolation (Q2(8)-Q1) and the Lagrangian biquadratic element with bilinear continuous pressure interpolation (Q2-Q1) of the Taylor-Hood form. A modified form of the Q-2Q1 element is also studied. The pressure interpolation is augmented by a discontinuous constant shape function for pressure (Q2-Q1+). The discontinuous pressure element formulation makes use of biquadratic shape functions and a discontinuous linear interpolation of the pressure (Q2-P1(3)). Laminar flow solutions, with heat transfer, are compared to analytical and computational benchmarks for flat channel, backward-facing step and buoyancy driven flow in a square cavity. It is shown that the discontinuous pressure elements provide superior solution characteristics over the continuous pressure elements. Highly accurate heat transfer solutions are obtained and the Q2-P1(3) element is chosen for extension to turbulent flow simulations. Turbulent flow solutions are presented for both low turbulence Reynolds number and high Reynolds number formulations of two equation turbulence models. The following three forms of the length scale transport equation are studied: the turbulence energy dissipation rate (epsilon), the turbulence frequency (omega) and the turbulence time scale (tau). It is shown that the low turbulence Reynolds number model consisting of the k-tau transport equations, coupled with the damping functions of Shih and Hsu, provides an optimal combination of numerical stability and solution accuracy for the flat channel flow. Attempts to extend the formulation beyond the flat channel were not successful due to oscillatory behavior of the solutions. It is shown that the Streamline-Upwind/Petrov-Galerkin (SUPG) formulation provides stable solutions for the advection diffusion equation with biquadratic elements. However, when coupled with the Newton-Raphson linearization method, convergence behavior is reduced to less than first order, leading to unattainable computer time requirements. The high Reynolds number form of the k-epsilon and k-omega turbulence models are applied to flat channel and backward-facing step flows using a wall function element. This biquadratic element has continuous law-of-the-wall shape functions normal to the wall. It is shown that the k-epsilon and k-omega models work well for the flat channel flow. The k-epsilon model gave acceptable results for the backward-facing step flow, while the k-omega model gave erroneous results. Qualitatively correct thermal solutions for turbulent flow can be achieved. Dissert. Abstr.

N93-23189# GKSS-Forschungszentrum Geesthacht (Germany). Inst. fuer Physik.
TURBULENCE MODELS FOR HELICAL FLOW Thesis - Tech. Univ. Hamburg [TURBULENZMODELLIERUNG FUER STROEMUNGEN MIT HELIZITAET]
R. Cieszelski 1992 144 p In GERMAN
(GKSS-92/E/12; ETN-93-93397) Copyright Avail: CASI HC A07/MF A02

Energy and helicity conservation are taken into account for subgrid turbulence modeling, in order to improve the vortex conservation of grid point models applied in meteorology. The influence of Turbulent Kinetic Energy and Helicity (TKEH) is considered for the mean flow equations. The subgrid scale model keeps the prognostic equation of turbulent kinetic energy and, in addition, the equation of turbulent helicity: the TKEH model. Two examples of simulation using TKEH modeling show improved vortex conservation, in comparison with diffuse turbulent kinetic energy modeling.

The simulated decay of a barotropic tropical cyclone segment is slowed down. TKEH modeling stabilizes the rotation of simulated thermals. ESA

N93-23220*# Alabama Univ., Huntsville. Coll. of Science.
KINETICS OF DIFFUSIONAL DROPLET GROWTH IN A LIQUID/LIQUID TWO-PHASE SYSTEM Final Report
James K. Baird and Judith B. Cain 12 Mar. 1993 67 p
(Grant NAG8-816)
(NASA-CR-192624; NAS 1.26:192624) Avail: CASI HC A04/MF A01

This report contains experimental results for the interdiffusion coefficient of the system, succinonitrile plus water, at a number of compositions and temperatures in the single phase region of the phase diagram. The concentration and temperature dependence of the measured diffusion coefficient has been analyzed in terms of Landau - Ginzburg theory, which assumes that the Gibb free energy is an analytic function of its variables, and can be expanded in a Taylor series about any point in the phase diagram. At most points in the single phase region this is adequate. Near the consolute point (critical point of solution), however, the free energy is non-analytic, and the Landau - Ginzburg theory fails. The solution to this problem dictates that the Landau - Ginzburg form of the free energy be replaced by Widom scaling functions with irrational values for the scaling exponents. As our measurements of the diffusion coefficient near the critical point reflect this non-analytic character, we are preparing for publication in a refereed journal a separate analysis of some of the data contained herein as well as some additional measurements we have just completed. When published, reprints of this article will be furnished to NASA.
Author (revised)

N93-23226 Illinois Univ., Urbana-Champaign.
OPERATOR SPLITTING METHODS FOR THE NAVIER-STOKES EQUATIONS Ph.D. Thesis
Bart David Semeraro 1992 139 p
Avail: CASI HC A07/MF A02

The properties of two algorithms for the solution of the incompressible Navier-Stokes equations are examined. These algorithms are representative of the two prevalent splitting philosophies used to split the Navier-Stokes equations. The properties of the algorithms are determined by Fourier analysis of a model problem. It is shown that splittings resulting in Stokes subproblems have desirable dissipative properties which are lacking in the velocity-pressure splittings. Algorithms for solving subproblems resulting from the splitting of the Navier-Stokes equations are introduced and compared to existing methods. The new methods are based on splitting of the Stokes matrix and subsequent orthogonal projection of the intermediate velocity onto a divergence free subspace. Algorithms based on several splittings are examined and compared to the conjugate gradient Uzawa algorithm. The split matrix scheme is accelerated by application of a Krylov subspace outer iteration. The accelerated scheme uses the conjugate gradient method if the iteration matrix is symmetric and positive definite and the Gmres algorithm if not. The accelerated scheme performed as well as or better than the Uzawa scheme. The nonlinear subproblem is preconditioned via an approximate Jacobian secant method. In this technique the secant method is accelerated by the application of a nonlinear Krylov method to the nonlinear system of equations which result in the application of Newtons method. The number of function evaluations required to solve the nonlinear system was greatly reduced by the application of the preconditioner.
Dissert. Abstr.

N93-23234*# MCAT Inst., San Jose, CA.
ALGORITHM AND CODE DEVELOPMENT FOR UNSTEADY THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS
Shigeru Obayashi Mar. 1993 82 p Original contains color illustrations
(Contract NCC2-605)
(NASA-CR-192760; NAS 1.26:192760; MCAT-93-08) Avail: CASI HC A05/MF A01; 3 functional color pages

In the last two decades, there have been extensive developments in computational aerodynamics, which constitutes a major part of the general area of computational fluid dynamics. Such developments are essential to advance the understanding of the physics of complex flows, to complement expensive wind-tunnel tests, and to reduce the overall design cost of an aircraft, particularly in the area of aeroelasticity. Aeroelasticity plays an important role in the design and development of aircraft, particularly modern aircraft, which tend to be more flexible. Several phenomena that can be dangerous and limit the performance of an aircraft occur because of the interaction of the flow with flexible components. For example, an aircraft with highly swept wings may experience vortex-induced aeroelastic oscillations. Also, undesirable aeroelastic phenomena due to the presence and movement of shock waves occur in the transonic range. Aeroelastically critical phenomena, such as a low transonic flutter speed, have been known to occur through limited wind-tunnel tests and flight tests. Aeroelastic tests require extensive cost and risk. An aeroelastic wind-tunnel experiment is an order of magnitude more expensive than a parallel experiment involving only aerodynamics. By complementing the wind-tunnel experiments with numerical simulations the overall cost of the development of aircraft can be considerably reduced. In order to accurately compute aeroelastic phenomenon it is necessary to solve the unsteady Euler/Navier-Stokes equations simultaneously with the structural equations of motion. These equations accurately describe the flow phenomena for aeroelastic applications. At Ames a code, ENSAERO, is being developed for computing the unsteady aerodynamics and aeroelasticity of aircraft and it solves the Euler/Navier-Stokes equations. The purpose of this contract is to continue the algorithm enhancements of ENSAERO and to apply the code to complicated geometries. During the last year, the geometric capability of the code was extended to simulate transonic flows, a wing with oscillating control surface. Single-grid and zonal approaches were tested. For the zonal approach, a new interpolation technique was introduced. The key development of the algorithm was an interface treatment between moving zones for a control surface using the virtual-zone concept. The work performed during the period, 1 Apr. 1992 through 31 Mar. 1993 is summarized. Additional details on the various aspects of the study are given in the Appendices.
Author (revised)

N93-23253# Marquette Univ., Milwaukee, WI. Dept. of Electrical Engineering.
APPLICATION OF A SAW DEVICE FOR MEASURING RATE OF GAS FLOW Final Report, Apr. 1991 - Jul. 1992
Shrinivas G. Joshi Sep. 1992 45 p Sponsored by Gas Research Institute, Chicago, IL
(Contract GRI-5091-260-2116)
(PB93-124931; GRI-92/0431) Avail: CASI HC A03/MF A01

The objective of the program is the development of a compact, high performance flow meter that will meet the specifications developed by the Gas Research Institute for the next generation of residential gas meters. A solid-state flow meter based on the use of surface acoustic wave (SAW) devices is considered for the application. Attractive features of SAW sensors include high sensitivity, wide dynamic range, direct digital output, small size, and low cost. In the exploratory research phase, a theoretical analysis of the operation of the SAW flow sensor was performed. This was then used to design a SAW device for the proposed application. Experimental measurements confirm that a single device can measure flow rates over the entire operating range of 118 ml/min. to 95 l/min. The accuracy of the sensor is better than the requirements by at least a factor of 10. Further work that needs to be done in order to reduce power consumption, improve speed of response, and reduce sensitivity to ambient temperature changes is discussed. Work done to date indicates that the SAW technique has good promise for realizing the next generation of residential gas meters.
Author

N93-23281# Creare, Inc., Hanover, NH.
EVALUATION OF NOZZLE SHAPES FOR AN OPTICAL FLOW METER Final Report, Sep. 1987 - Feb. 1989
M. Z. Sheikholeslami and B. R. Patel May 1992 34 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5086-271-1269)
(PB93-124147; CREARE-TM-1475B; GRI-92/0060.3) Avail: CASI HC A03/MF A01

Numerical modeling is performed for turbulent flow in axisymmetric nozzles using Creare's computer program FLUENT/BFC. The primary objective of the project was to assist Spectron Development Laboratories in selecting an optimum nozzle shape for an optical flowmeter. The nozzle performance is evaluated for various length to diameter ratios, area contraction ratios, and Reynolds numbers. The computations have demonstrated that a cubic profile nozzle with length to diameter ratio of 1.6 and area contraction ratio of 6.2 can decrease the velocity profile

non-uniformity from 15 percent at the entrance to 1 percent at the exit. The configuration is recommended for further investigation. GRA

N93-23299# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
FULLY IMPLICIT SOLUTIONS OF THE BENCHMARK BACKWARD FACING STEP PROBLEM USING FINITE ELEMENT DISCRETIZATION AND INEXACT NEWTON'S METHOD
P. R. McHugh and D. A. Knoll 1992 12 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA, 8-13 Nov. 1992
(Contract DE-AC07-76ID-01570)
(DE93-005246; EGG-M-92411; CONF-921110-45) Avail: CASI HC A03/MF A01

A fully implicit solution algorithm based on Newton's method is used to solve the steady, incompressible Navier-Stokes and energy equations. An efficiently evaluated numerical Jacobian is used to simplify implementation, and mesh sequencing is used to increase the radius of convergence of the algorithm. Finite volume discretization using the power law scheme of Patankar to solve the benchmark backward facing step problem defined by the ASME K-12 Aerospace Heat Transfer Committee is employed. LINPACK banded Gaussian elimination and the preconditioned transpose-free quasi-minimal residual (TFQMR) algorithm of Freund are studied as possible linear equation solvers. Implementation of the preconditioned TFQMR algorithm requires use of the switched evolution relaxation algorithm of Mulder and Van Leer to ensure convergence. The preconditioned TFQMR algorithm is more memory efficient than the direct solver, but our implementation is not as CPU efficient. Results show that for the level of grid refinement used, power law differencing was not adequate to yield the desired accuracy for this problem. DOE

N93-23300# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
A COMBINED GALERKIN/COLLOCATION SPECTRAL METHOD FOR TRANSIENT SOLUTION OF FLOW PAST A SPHERICAL DROPLET
H. D. Nguyen, S. Paik, and J. N. Chung (Washington State Univ., Pullman.) 1992 7 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA, 8-13 Nov. 1992
(Contract DE-AC07-76ID-01570)
(DE93-005251; EGG-M-92220; CONF-921110-47) Avail: CASI HC A02/MF A01

A spectral model, based on the stream function and vorticity, is developed in order to calculate the time-dependent solution of flow past a spherical droplet. Both Chebyshev and Legendre polynomials are used to expand the stream function and vorticity in the radial and angular directions, respectively, along with the backward Euler approximation to advance in time. Consistent treatment of boundary conditions is made to resolve the lack of vorticity boundary conditions by means of the influence matrix technique. The computed flow field, the drag coefficient, and the interfacial velocity are presented for Reynolds numbers in the range from 0.5 to 50 for both continuous and dispersed phases with viscosity ratios of 1 and 3. Comparison of the present results to those found in the literature indicate that the model is capable of predicting the correct nature of the flow associated with a droplet. DOE

N93-23339# Lowell Univ., MA. Dept. of Electrical Engineering.
STABILITY AND HEAT TRANSFER IN TIME-MODULATED FLOWS
C. Thompson 1992 29 p
(Contract DE-FG02-91ER-14179)
(DE93-006423; DOE/ER-14179/2) Avail: CASI HC A03/MF A01

Research activities currently underway in the Laboratory for Advanced Computation at the University of Massachusetts - Lowell are outlined. A summary of the results for the period Nov. 1991 - Nov. 1992 conducted under the program is given. Topics covered include: chaotic secondary motion in oscillatory boundary layers; space-time evolution of unstable disturbances in a Stokes boundary layer; characterization of the velocity in chaotic unsteady flows; ultrasonic characterization of vortical structures; and construction and evaluation of the experiment. DOE

N93-23349# Creare, Inc., Hanover, NH.
NUMERICAL SIMULATION OF FLOW THROUGH ORIFICE METERS Final Report, Sep. 1987 - Mar. 1991
J. J. Barry, M. Z. Sheikholeslami, and B. R. Patel May 1992 68 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5086-271-1269)
(PB93-124121; CREARE-TM-1475A; GRI-92/0060.1) Avail: CASI HC A04/MF A01

The FLUENT and FLUENT/BFC computer programs have been used to numerically model turbulent flow through orifice meters. These simulations were based on solution of the Navier-Stokes equations incorporating a k-epsilon turbulence model. For ideal installations, trends in the discharge coefficient with Reynolds number, beta ratio, and surface roughness have been reproduced, and the value of the discharge coefficient has been computed to within 2 percent. Nonideal installations have also been simulated, including the effects of expanders, reducers, valves, and bends. Detailed modeling of flow through a bend has yielded results in good agreement with experimental data. The trend in discharge coefficient shifts for orifice meters downstream of bends has been predicted reasonably well. Author

N93-23361# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
ON WAVE FORCE ANALYSIS USING SYSTEM IDENTIFICATION
K. Worden (Oxford Univ., England.), P. K. Stansby (Oxford Univ., England.), G. R. Tomlinson (Oxford Univ., England.), and S. A. Billings Apr. 1992 17 p Presented at the Behavior of Offshore Structures Confernce, Imperial Coll., London, England, 7-10 Jul. 1992 Sponsored by Health and Safety Executive Offshore Safety Division, London
(RR-450; ETN-93-93491) Avail: CASI HC A03/MF A01

A review of work on improving the predictive capabilities of the Morison equation for wave force analysis in both the time and frequency domain using system identification is presented. System identification requires samples of time data for force and flow velocity; data from a U tube, the De Voorst wave flume, and the Cristchurch Bay tower, is considered. The results obtained in the time domain include an improved classification of wave forces and excellent predictions of measured forces although the model structures are case specific. A series expansion for the force spectrum is proposed via the Morison-Duffing equation which promises more accurate modeling of high frequency components in the force histories for general application. This has implications for fatigue analysis. The use of neural networks to model dynamical systems is discussed. ESA

N93-23386 Maryland Univ., College Park.
OSCILLATING-BODY VISCOMETRY AND ITS APPLICATION TO PHASE-SEPARATING LIQUID MIXTURES Ph.D. Thesis
Alfred Henry Krall, Jr. 1992 357 p
Avail: Univ. Microfilms Order No. DA9234598

This work is concerned with the theory and applications of oscillating-body viscometers. A review is presented of the derivation of accurate equations linking the period and decay rate of the body's oscillatory motion with the surrounding fluid's viscosity and density. For the case of an oscillating-disk viscometer, the possibility of a simultaneous determination of both fluid properties is investigated by analytic and numerical methods. In particular, attention is called to the subtle effect of the fixed plates often located above and below the disk. The practicality of the simultaneous determination of viscosity and density, which allows one to measure the viscosity without prior knowledge of the density, is demonstrated experimentally in measurements performed on liquid toluene. The apparatus used for this purpose is described in detail. New, precise data of the viscosity of toluene over a wide range of temperatures and pressures are presented. In the second half of this dissertation, the viscometer is applied to problems of current interest in critical phenomena and systems far from equilibrium. The exponent of the critical divergence of viscosity is measured for a binary liquid mixture near the consolute point. Measurements are made during quench-induced phase separation in order to study the rheological effects of concentration domains. Large enhancements of the viscosity are observed under these conditions, in agreement with the suggestion of Onuki. A main result is the discovery of shear elasticity, even at very low frequencies, in mixtures of simple liquids under these conditions. Mixtures of critical and off-critical compositions are found to exhibit qualitatively different behavior. These differences are interpreted as consequences of different domain morphologies and growth mechanisms. Dissert. Abstr.

N93-23398 Heriot-Watt Univ., Edinburgh (Scotland).
DEVELOPMENT OF OPTICAL THREE-DIMENSIONAL MEASUREMENT TECHNIQUES FOR FLUID DYNAMICS Ph.D. Thesis
Yang Zhao 1992 250 p
Avail: Univ. Microfilms Order No. BRDX97959

This thesis presents two new optical methods which enable the simultaneous measurement of the three components of fluid velocity over an extended volume of a flow. The first, termed stereo particle image velocimetry, was an adaptation of the conventional particle image velocimetry (PIV) method. The second combined in-line holographic methods used with a stereo viewing technique. This method, named stereo in-line holography, enabled the location of seed particle positions along the recording optical axis to be more accurately defined. The image processing algorithms used in this procedure were also found to be extremely efficient. Special emphasis is placed on stereo camera modeling and the recovery of 3-D information from 2-D perspective images. Stereo image processing techniques are discussed which enable the matching of the two stereo images to be made more precisely. The stereo measurement facility developed for PIV was also adapted to provide information about the surface profile of freely propagating gravity water waves. Results and conclusions are presented based on the application of each technique to a variety of flows (air and water). The stereo PIV method was suited for use in the measurement over a wide velocity range, whereas the holographic method as described could be used only to investigate low speed flows. Both methods require low seeding density. Dissert. Abstr.

N93-23402 Arizona State Univ., Tempe.
RECEPTIVITY OF THE BOUNDARY LAYER OVER A FLAT PLATE WITH DIFFERENT LEADING-EDGE GEOMETRIES: NUMERICAL SIMULATIONS Ph.D. Thesis
Nay Lin 1992 183 p
Avail: Univ. Microfilms Order No. DA9237267

The receptivity to freestream oscillations of the laminar boundary layer over a semi-infinite flat plate of finite thickness is simulated numerically. The incompressible flow past the flat plate is computed by solving the full Navier-Stokes equations in general curvilinear coordinates. A finite-difference method which is second-order accurate in space and time is used. Spatial and temporal developments of the Tollmien-Schlichting wave in the boundary layer, due to small-amplitude time-harmonic oscillations of the freestream velocity that closely simulate a sound wave traveling parallel to the plate for incompressible flow, are observed. The effect of leading-edge geometry is studied by using leading edges with different aspect ratios. The boundary layer over the flat plate with a sharper elliptic leading edge is found to be less receptive. A new leading-edge geometry, a modified super-ellipse, which provides continuous curvature at the juncture with the flat plate, is used to study the effect of continuous curvature and inherent pressure gradient on receptivity. It is found that receptivity magnitude depends on how rapid the pressure gradient changes along the wall, and for a given aspect ratio, there is an optimum variation of the leading-edge curvature for minimum receptivity. Moreover, the phase of the instability wave is determined by the location of the maximum adverse-pressure gradient along the wall. The threshold of linearity of the instability-wave response with respect to the freestream amplitude is investigated. The applicability of the linearized form of disturbance equations for this receptivity problem is also demonstrated. Dissert. Abstr.

N93-23404*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TRANSIENT LIQUID-CRYSTAL TECHNIQUE USED TO PRODUCE HIGH-RESOLUTION CONVECTIVE HEAT-TRANSFER-COEFFICIENT MAPS
Steven A. Hippensteele and Philip E. Poinsatte Aug. 1993 11 p
Proposed for presentation at the 1993 National Heat Transfer Conference, Atlanta, GA, 8-11 Aug. 1993; sponsored by ASME
(RTOP 505-62-52)
(NASA-TM-106083; E-7702; NAS 1.15:106083) Avail: CASI HC A03/MF A01

In this transient technique the preheated isothermal model wall simulates the classic one-dimensional, semi-infinite wall heat transfer conduction problem. By knowing the temperature of the air flowing through the model, the initial temperature of the model wall, and the surface cooling rate measured at any location with time (using the fast-response liquid-crystal patterns recorded on video tape), the heat transfer coefficient can be calculated for the color isothermal pattern produced. Although the test was run transiently, the heat transfer coefficients are for the steady-state case. The upstream thermal boundary condition was considered to be isothermal. This transient liquid-crystal heat-transfer technique was used in a transient air tunnel in which a square-inlet, 3-to-1 exit transition duct was placed. The duct was preheated prior to allowing room temperature air to be suddenly drawn through it. The resulting isothermal contours on the duct surfaces were revealed using a surface coating of thermochromic liquid crystals that display distinctive colors at particular temperatures. A video record was made of the temperature and time data for all points on the duct surfaces during each test. The duct surfaces were uniformly heated using two heating systems: the first was an automatic temperature-controlled heater blanket completely surrounding the test duct like an oven, and the second was an internal hot-air loop through the inside of the test duct. The hot-air loop path was confined inside the test duct by insulated heat dams located at the inlet and exit ends of the test duct. A recirculating fan moved hot air into the duct inlet, through the duct, out of the duct exit, through the oven, and back to the duct inlet. The temperature nonuniformity of the test duct model wall was held very small. Test results are reported for two inlet Reynolds numbers of 200,000 and 1,150,000 (based on the square-inlet hydraulic diameter) and two free-stream turbulence intensities of about 1 percent, which is typical of wind tunnels, and up to 20 percent (using a grid), which is typical of real engine conditions. Author (revised)

N93-23409*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
A MULTIPLE SCALES APPROACH TO SOUND GENERATION BY VIBRATING BODIES Final Report
James F. Geer (State Univ. of New York, Binghamton.) and Dennis S. Pope (Lockheed Engineering and Sciences Co., Hampton, VA.) Washington Dec. 1992 46 p Submitted for publication
(Contracts NAS1-18605; NAS1-19480)
(NASA-CR-191414; NAS 1.26:191414; ICASE-92-73) Avail: CASI HC A03/MF A01

The problem of determining the acoustic field in an inviscid, isentropic fluid generated by a solid body whose surface executes prescribed vibrations is formulated and solved as a multiple scales perturbation problem, using the Mach number M based on the maximum surface velocity as the perturbation parameter. Following the idea of multiple scales, new 'slow' spacial scales are introduced, which are defined as the usual physical spacial scale multiplied by powers of M. The governing nonlinear differential equations lead to a sequence of linear problems for the perturbation coefficient functions. However, it is shown that the higher order perturbation functions obtained in this manner will dominate the lower order solutions unless their dependence on the slow spacial scales is chosen in a certain manner. In particular, it is shown that the perturbation functions must satisfy an equation similar to Burgers' equation, with a slow spacial scale playing the role of the time-like variable. The method is illustrated by a simple one-dimenstional example, as well as by three different cases of a vibrating sphere. The results are compared with solutions obtained by purely numerical methods and some insights provided by the perturbation approach are discussed. Author (revised)

N93-23417*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE THREE-DIMENSIONAL EVOLUTION OF A PLANE MIXING LAYER. PART 2: PAIRING AND TRANSITION TO TURBULENCE
Robert D. Moser and Michael M. Rogers Dec. 1992 91 p
(RTOP 505-59-53)
(NASA-TM-103926; A-92068; NAS 1.15:103926) Avail: CASI HC A05/MF A01

The evolution of three-dimensional temporally evolving plane mixing layers through as many as three pairings was simulated numerically. Initial conditions for all simulations consisted of a few low-wavenumber disturbances, usually derived from linear stability theory, in addition to the mean velocity. Three-dimensional perturbations were used with amplitudes ranging from infinitesimal to large enough to trigger a rapid transition to turbulence. Pairing is found both to inhibit the growth of infinitesimal three-dimensional disturbances and to trigger the transition to turbulence in highly three dimensional flows. The mechanisms responsible for the growth

of three-dimensionality as well as the initial phases of the transition to turbulence are described. The transition to turbulence is accompanied by the formation of thin sheets of span wise vorticity, which undergo a secondary roll up. Transition also produces an increase in the degree of scalar mixing, in agreement with experimental observations of mixing transition. Simulations were also conducted to investigate changes in span wise length scale that may occur in response to the change in stream wise length scale during a pairing. The linear mechanism for this process was found to be very slow, requiring roughly three pairings to complete a doubling of the span wise scale. Stronger three-dimensionality can produce more rapid scale changes but is also likely to trigger transition to turbulence. No evidence was found for a change from an organized array of rib vortices at one span wise scale to a similar array at a larger span wise scale.
Author (revised)

N93-23421*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
RENORMALIZATION GROUP ESTIMATES OF TRANSPORT COEFFICIENTS IN THE ADVECTION OF A PASSIVE SCALAR BY INCOMPRESSIBLE TURBULENCE Final Report
Ye Zhou and George Vahala Washington Feb. 1993 31 p Submitted for publication Sponsored by NASA. Langley Research Center
(Contract NAS1-19480; RTOP 505-90-52-01)
(NASA-CR-191421; NAS 1.26:191421; ICASE-93-1) Avail: CASI HC A03/MF A01

The advection of a passive scalar by incompressible turbulence is considered using recursive renormalization group procedures in the differential sub grid shell thickness limit. It is shown explicitly that the higher order nonlinearities induced by the recursive renormalization group procedure preserve Galilean invariance. Differential equations, valid for the entire resolvable wave number k range, are determined for the eddy viscosity and eddy diffusivity coefficients, and it is shown that higher order nonlinearities do not contribute as k goes to 0, but have an essential role as k goes to k(sub c) the cutoff wave number separating the resolvable scales from the sub grid scales. The recursive renormalization transport coefficients and the associated eddy Prandtl number are in good agreement with the k-dependent transport coefficients derived from closure theories and experiments. Author (revised)

N93-23485# Wright Lab., Eglin AFB, FL.
TRANSIENT SIMULATION OF RAM ACCELERATOR FLOWFIELDS Final Report, Jun. - Sep. 1992
Randall P. Drabczuk, G. Rolader, S. Dash, N. Sinha, and B. York Jan. 1993 22 p
(AD-A259767; WL-TP-92-014) Avail: CASI HC A03/MF A01

This paper describes the development of an advanced computational fluid dynamic (CFD) simulation capability in support of the USAF Armament Directorate ram accelerator research initiative. The state-of-the-art CRAFT computer code has been specialized for high fidelity, transient ram accelerator simulations via inclusion of generalized dynamic gridding, solution adaptive grid clustering, and high pressure thermo-chemistry. Selected ram accelerator simulations are presented that serve to exhibit the CRAFT code capabilities and identify some of the principle research/design Issues. GRA

N93-23496 Pennsylvania State Univ., University Park.
AN INVESTIGATION OF PARTICLE TURBULENCE QUANTITIES IN A DENSE TWO-PHASE PIPE FLOW, USING LASER DOPPLER VELOCIMETRY Ph.D. Thesis
Christopher Abbott Cline 1992 178 p
Avail: Univ. Microfilms Order No. DA9236801

The mean and turbulence statistics for the solid phase of a liquid-sold two-phase turbulent pipe flow were studied for particle concentrations up to 12.5 percent by volume. The Reynolds number based on the pipe diameter and the liquid kinematic viscosity was 14500, while the Reynolds number based on the mixture kinematic viscosity ranged from 9400 to 14500. The test section was 44 pipe diameters downstream of the pipe entrance. Measurements were made as close as one wall unit from the wall, using a two-component laser Doppler velocimeter. The calculated velocity statistics included the mean through fourth order central moments, cross correlation, and triple correlations. The working liquid was an aqueous sodium iodide solution which matched the index of refraction of the acrylic pipe and acrylic test at the wavelengths of the argon-ion laser. The particles had a mean diameter of 150 microns and a size dispersion of 50 to 180 microns. The particles were less dense than the liquid, with a particle-to-liquid density ratio of 0.66. the particle Reynolds number was less than 100. Measurements in an unladen pipe flow were in very good agreement with previous investigations, with the exception of elevated axial and radial turbulence intensities. The elevated values were attributed to the pipe wall or LDV measurement volume vibrating. The particle mean velocity in the particle-laden flow followed the same law of the wall relationship as for an unladen fluid when inner scaling was done based on the bulk mixture properties. All profiles of the particle turbulence quantities were similar in shape and behavior to the unladen liquid profiles, with most profiles being self-similar with particle concentration. This suggests that the particles behave more or less like fluid elements embedded in a continuous fluid. The results also indirectly suggest that the particles are affecting the coherent turbulence structures that are responsible for turbulence production in the wall region. Dissert. Abstr.

N93-23591 Syracuse Univ., NY.
WAKE-INDUCED UNSTEADY STAGNATION REGION HEAT TRANSFER MEASUREMENTS Ph.D. Thesis
Patrick Joseph Magari 1992 247 p
Avail: Univ. Microfilms Order No. DA9229689

An experimental investigation of wake-induced unsteady heat transfer in the stagnation region of a cylinder is presented. The objective of the study was to create a quasi-steady representation of the stator/rotor interaction in a gas turbine using two stationary cylinders. In this simulation, a larger cylinder, representing the leading-edge region of a rotor blade was immersed in the wake of a smaller cylinder, representing the trailing-edge region of a stator vane. The experiment was conducted in a short-duration, compression-heated wind tunnel which allowed for independent control of Mach number, Reynolds number, and gas-to-wall temperature ratio. Measurements were performed at a gas-to-wall temperature ratio of 1.35 and Mach numbers of 0.1 and 0.5 with range of 67,500-112,000 and 112,000-383,000, respectively. The background freestream turbulence intensity was less than 0.5 percent, and turbulence grids were utilized to enhance these levels to 4.5 percent at M infinity = 0.08 and 1.75 percent at M infinity = 0.5. Low-speed, isolated-cylinder heat-transfer results compared well with the results of previous investigations, but at the transonic Mach number (M infinity = 0.5), the heat-transfer rate decreased faster with the circumferential distance from the stagnation point. The wake-interaction results were obtained with two wake-generating cylinder diameters of 0.25 and 0.125 times the instrumented cylinder diameter. The streamwise separations between the leading edge of the instrumented cylinder and the centerline of the wake-generating cylinder were 8 and 16 wake-generator diameters. The mean and rms variation of the heat-transfer signals, cross-correlations between various gauges, and spectral analyses of the unsteady heat-transfer signals are presented. The stagnation-point heat transfer was found to reach a maximum independent of the Reynolds number and wake-generator diameter when presented in terms of the Frossling number (NU/square root of Re) at high values of the turbulence parameter Tu/square root of Re. Freestream turbulence levels had no appreciable effect upon the results. The power spectra and wavelet transforms of the heat-transfer signals revealed the importance of large vortical structures in the wake to the unsteady component of the heat transfer in the stagnation region. Dissert. Abstr.

N93-23592 Stanford Univ., CA.
NUMERICAL STUDY OF AXIAL TURBULENT FLOW OVER LONG CYLINDERS Ph.D. Thesis
Joao Correia Neves 1992 170 p
Avail: Univ. Microfilms Order No. DA9234139

Convex transverse curvature effects in wall bounded turbulent flows are significant if the boundary layer thickness is large compared to the radius of curvature. The curvature affects the inner part of the flow if a(+), the cylinder radius in wall units, is small. This flow regime is common in sonar devices towed by long cables. Two direct numerical simulations of transversely curved flows were performed and statistical and structural data were extracted from the computed flow fields. The effects of the transverse curvature were identified by comparing the present results with those of the plane channel simulation, performed at a similar Reynolds number. As expected, the transversely curved turbulent flow exhibits many

features common to the planar flows: near-wall low speed streaks, near-wall inclined shear layers, near-wall streamwise vortices, Reynolds shear stress dominated by second and fourth quadrant events, etc. As the curvature increases, the skin friction increases, the slope of the logarithmic region decreases and turbulence intensities are reduced. Several turbulence statistics are found to scale with a curvature dependent velocity scale derived from the mean momentum equation. Near the wall, the flow is more anisotropic than in the plane channel with a larger percentage of the turbulent kinetic energy resulting from the streamwise velocity fluctuations. Near-wall streamwise vortices are the strongest sources of pressure fluctuations. As the curvature increases, regions of strong normal vorticity develop near the wall. As the curvature increases the wall pressure fluctuations are dominated by smaller spanwise length scales. Fractional contributions from various layers in the flow to the wall r.m.s. pressure are marginally affected by the curvature. The ratio of the axial to azimuthal length scales of the wall pressure fluctuations increase with increasing curvature. Curvature dependent time and length scales are identified that collapse the high frequency range of the wall pressure temporal spectra and the high wave number range of the wall pressure streamwise spectra of flows with different curvatures. Taylor's hypothesis holds for the wall pressure fluctuations with a lower convection velocity than in the planar case. Dissert. Abstr.

N93-23593 California Univ., Irvine.
DETERMINING NODES AND LONG-TIME APPROXIMATIONS TO THE NAVIER-STOKES EQUATIONS Ph.D. Thesis
Donald Arthur Jones, Jr. 1992 100 p
Avail: Univ. Microfilms Order No. DA9233674

Our main interest in this work is the study of the asymptotic behavior of solutions of the Navier-Stokes equations in bounded domains. It is known that if the large time behavior of the solutions to the Navier-Stokes equations is known on an appropriate finite set (nodal values), then the large time behavior of the solution itself is totally determined. We rigorously establish an upper-bound for the number of nodes needed to determine the solutions in two dimensions with periodic boundary conditions. We introduce the notion of determining finite volume elements, and we provide an upper bound on the number needed to determine the solutions in terms of the physical parameters of the problem. We also consider the 2D Navier-Stokes equations with time dependent external body forces. Under appropriate assumptions on the temporal properties of the forcing term we are able to construct a time dependent approximate inertial manifold. The particular manifold we construct is known by meteorologists as a slow manifold. We are also able to estimate the error resulting in the associated nonlinear Galerkin method. If the forcing term is too oscillatory in time, we show by example that the techniques used in the construction of certain approximate inertial manifolds for the autonomous case, in general, do not extend to the time dependent case. On the other hand, if the forcing term is time independent but smooth (Gevrey class), then, in general, the approximate inertial manifolds constructed for this case lead to an algebraic improvement over an already exponentially close flat manifold (Galerkin scheme). Finally, we present a numerical scheme based on the methodology of approximate inertial manifolds to a finite difference scheme. We perform a parameter study in which we compare the accuracy of a standard scheme with our modified scheme. Dissert. Abstr.

N93-23688# Argonne National Lab., IL.
HIGH PERFORMANCE MICROCHANNEL HEAT EXCHANGER FOR COOLING HIGH HEAT LOAD X RAY OPTICAL ELEMENTS
U. S. Choi, C. S. Rogers, and D. M. Mills 1992 12 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA, 8-13 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-004245; ANL/CP-75344; CONF-921110-40) Avail: CASI HC A03/MF A01

Analysis has been carried out to demonstrate that a liquid nitrogen cooled microchannel heat exchanger can be designed to maximize the heat transfer from silicon to the working fluid. The results show that the performance of the liquid nitrogen cooled microchannel heat exchanger is significantly enhanced by approximately three times over flowing water through microchannels. DOE

N93-23724*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
DEVELOPMENT OF ITERATIVE TECHNIQUES FOR THE SOLUTION OF UNSTEADY COMPRESSIBLE VISCOUS FLOWS Final Technical Report, 14 Feb. 1991 - 13 Feb. 1993
Duane Hixon and L. N. Sankar Mar. 1993 162 p
(Grant NAG1-1217)
(NASA-CR-192636; NAS 1.26:192636) Avail: CASI HC A08/MF A02

During the past two decades, there has been significant progress in the field of numerical simulation of unsteady compressible viscous flows. At present, a variety of solution techniques exist such as the transonic small disturbance analyses (TSD), transonic full potential equation-based methods, unsteady Euler solvers, and unsteady Navier-Stokes solvers. These advances have been made possible by developments in three areas: (1) improved numerical algorithms; (2) automation of body-fitted grid generation schemes; and (3) advanced computer architectures with vector processing and massively parallel processing features. In this work, the GMRES scheme has been considered as a candidate for acceleration of a Newton iteration time marching scheme for unsteady 2-D and 3-D compressible viscous flow calculation; from preliminary calculations, this will provide up to a 65 percent reduction in the computer time requirements over the existing class of explicit and implicit time marching schemes. The proposed method has ben tested on structured grids, but is flexible enough for extension to unstructured grids. The described scheme has been tested only on the current generation of vector processor architecture of the Cray Y/MP class, but should be suitable for adaptation to massively parallel machines.
Author

N93-23736*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A MULTIPLE-SCALE MODEL FOR COMPRESSIBLE TURBULENT FLOWS
William W. Liou and Tsan-Hsing Shih Mar. 1993 23 p
(Contract NCC3-233; RTOP 505-90-5K)
(NASA-TM-106072; ICOMP-93-07; CMOTT-93-02; E-7679; NAS 1.15:106072) Avail: CASI HC A03/MF A01

A multiple-scale model for compressible turbulent flows is proposed. It is assumed that turbulent eddy shocklets are formed primarily by the 'collisions' of large energetic eddies. The extra straining of the large eddy, due to their interactions with shocklets, enhances the energy cascade to smaller eddies. Model transport equations are developed for the turbulent kinetic energies and the energy transfer rates of the different scale. The turbulent eddy viscosity is determined by the total turbulent kinetic energy and the rate of energy transfer from the large scale to the small scale, which is different from the energy dissipation rate. The model coefficients in the modeled turbulent transport equations depend on the ratio of the turbulent kinetic energy of the large scale to that of the small scale, which renders the model more adaptive to the characteristics of individual flow. The model is tested against compressible free shear layers. The results agree satisfactorily with measurements. Author (revised)

N93-23744*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPRAY COMBUSTION EXPERIMENTS AND NUMERICAL PREDICTIONS
Edward J. Mularz, Daniel L. Bulzan, and Kuo-Huey Chen (Toledo Univ., OH.) 1993 23 p Proposed for presentation at the AGARD Symposium on Fuels and Combustion Technology for Advanced Gas Turbine Engines, Rome, Italy, Spring 1993; sponsored by the Advisory Group for Aerospace Research and Development Original contains color illustrations
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-106069; E-7647; NAS 1.15:106069; ARL-MR-69) Avail: CASI HC A03/MF A01; 2 functional color pages

The next generation of commercial aircraft will include turbofan engines with performance significantly better than those in the current fleet. Control of particulate and gaseous emissions will also be an integral part of the engine design criteria. These performance and emission requirements present a technical challenge for the combustor: control of the fuel and air mixing and control of the local stoichiometry will have to be maintained much more rigorously than with combustors in current production. A better understanding of the flow physics of liquid fuel spray combustion is necessary. This paper describes recent experiments on spray combustion where detailed measurements of the spray characteristics were made,

including local drop-size distributions and velocities. Also, an advanced combustor CFD code has been under development and predictions from this code are compared with experimental results. Studies such as these will provide information to the advanced combustor designer on fuel spray quality and mixing effectiveness. Validation of new fast, robust, and efficient CFD codes will also enable the combustor designer to use them as additional design tools for optimization of combustor concepts for the next generation of aircraft engines. Author

N93-23865# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.

BOTTOM GENERATED VELOCITY FLUCTUATIONS IN ONE-DIMENSIONAL OPEN CHANNEL FLOW

Bartele deJong Apr. 1992 21 p

(MEMO-1051; ETN-93-93191) Avail: CASI HC A03/MF A01

A method to calculate statistical characteristics of velocity fluctuations in a one dimensional open channel flow with a given vertical velocity profile and with irregular bottom waves, characterized by the spectral density function is proposed. The method is based on a calculation of the velocity fluctuations in the fluid generated by a harmonic corrugation of the bottom. Since linearized dynamical equations are used the velocity fluctuations due to random bottom disturbances may be obtained by superposition. The dynamics of the motion is assumed to be governed by the Orr-Sommerfeld equation representing the internal wave motion in the fluid. This equation is solved in an approximate manner by reducing it in the upper layer of the fluid to the inviscid Rayleigh equation. Close to the bottom it is simplified to a shape still containing the essentials of the viscous behavior of the flow. Numerical examples and a qualitative comparison to experimental data are given. ESA

N93-23871# Alenia Aeronautica, Pomigliano D'Arco (Italy). Gruppo Aerei Trasporto.

AN INVESTIGATION OF MULTI-BLOCK STRUCTURED ALGORITHMS FOR PARALLEL CFD APPLICATIONS BY A SOLUTION OF 1D BURGERS EQUATION

C. deNicola (Naples Univ., Italy.), L. Paparone (Consiglio Nazionale delle Ricerche, Naples , Italy.), and R. Tognaccini 1991 15 p Presented at 11th AIDAA Conference, Forli, Italy, 14-18 Oct. 1991

(ETN-93-93703) Avail: CASI HC A03/MF A01

The application of a multiblock structured approach for the solution of the 1D (one dimensional) Burgers equation in distributed memory parallel architectures is illustrated. Numerical results and parallel performance concerning the use of two explicit methods and one implicit method to solve the Euler/Navier-Stokes equations are compared. ESA

N93-24075# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerospace.

RESTORING MONOTONICITY OF SLOWLY-MOVING SHOCKS COMPUTED WITH GODUNOV-TYPE SCHEMES

S. J. Billett and E. F. Toro Mar. 1992 25 p

(Cranfield-Aero-9207; ISBN-1-871564476; ETN-93-93555) Avail: CASI HC A03/MF A01; Cranfield Inst. of Technology, Coll. of Aeronautics, Cranfield, Bedford MK43 OAL, United Kingdom, HC

Using the isothermal gas equations, the problem of loss of monotonocity behind slowly moving shock waves as computed by Godunov type schemes is addressed. A parameter by which slow shocks can be detected within a flow field and a modification of Godunov's scheme which introduces numerical dissipation into the flow to damp the oscillations are presented. The scheme is extended to second order in smooth flow. ESA

N93-24096*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

STATIC AND AEROTHERMAL TESTS OF A SUPERALLOY HONEYCOMB PREPACKAGED THERMAL PROTECTION SYSTEM

Mark P. Gorton (Lockheed Engineering and Sciences Co., Hampton, VA.), John L. Shideler, and Granville L. Webb Washington Mar. 1993 51 p (RTOP 506-43-71-04)

(NASA-TP-3257; L-17084; NAS 1.60:3257) Avail: CASI HC A04/MF A01

A reusable metallic thermal protection system has been developed for vehicles with maximum surface temperatures of up to 2000 F. An array of two 12- by 12-in. panels was subjected to radiant heating tests that simulated Space Shuttle entry temperature and pressure histories. Results indicate that this thermal protection system, with a mass of 2.201 lbm/ft(exp 2), can successfully prevent typical aluminum primary structure of an entry vehicle like the Space Shuttle from exceeding temperatures greater than 350 F at a location on the vehicle where the maximum surface temperature is 1900 F. A flat array of 20 panels was exposed to aerothermal flow conditions, at a Mach number of 6.75. The panels were installed in a worst-case orientation with the gaps between panels parallel to the flow. Results from the aerothermal tests indicated that convective heating occurred from hot gas flow in the gaps between the panels. Proposed design changes to prevent gap heating occurred from hot gas flow in the gaps between the panels. Proposed design changes to prevent gap heating include orienting panels so that gaps are not parallel to the flow and using a packaged, compressible gap-filler material between panels to block hot gas flow in the gaps. Author

N93-24132# Naval Research Lab., Washington, DC.

MEASUREMENT AND INTERPRETATION FOR THE TURBULENT FLOW WALL PRESSURE FIELD OF A DILUTE POLYMER SOLUTION WITHIN A RECTANGULAR CHANNEL CONTAINING SMOOTH WALLS Final Report

Michael P. Horne 8 Jan. 1993 25 p

(NR Proj. RR0-23)

(AD-A260149; NRL/MR/7221-93-7176) Avail: CASI HC A03/MF A01

Measurements of the one and two-point spectral statistics of the wall pressure field were conducted within a smooth-wall turbulent channel flow containing both Newtonian (water) and non-Newtonian liquids. The test section of the channel was located far enough downstream to insure fully developed turbulence and the high aspect ratio of the channel (18:1) provided homogeneity of the flow in the transverse direction. Single component laser Doppler velocimetry (LDV) measurements were conducted in both the Newtonian and non-Newtonian cases in order to validate the channel kinematics and aid in the interpretation of the pressure fluctuation statistics. Reynolds number effects were examined and compared to similar experimental results in the literature. Recently developed signal processing techniques were utilized to enhance the statistical quality of the wall pressure field at low frequencies and those results pertaining to the polymer flow regime are believed to be the first of such high quality. The most interesting feature indicated from the pressure statistics is the loss of information at high frequencies which contain eddies at the smallest scales. Furthermore, the pressure spectra scaled on outer variables suggest that the limits on this smallest scale can be related to the relaxation time of the polymer molecule. At the present time, it is believed that non-Newtonian fluids primarily affect the production of turbulence energy. However, results from the single point pressure statistics suggest that polymer flows enhance a fluid's ability to dampen out turbulence via dissipation. GRA

N93-24141# Institute of Gas Technology, Chicago, IL.

COMBINED CONVECTIVE RADIATIVE HEAT TRANSFER ENHANCEMENT IN AN ADVANCED GAS-FIRED SURFACE COMBUSTOR HEATER Annual Report, Mar. 1991-1992

Tian Yu Xiong and Boris Kramnik Dec. 1992 68 p Sponsored by Gas Research Inst., Chicago, IL

(Contract GRI-5090-260-1927)

(PB93-138915; GRI-92/0434) Avail: CASI HC A04/MF A01

A theoretical model development is being pursued at Purdue University. The purpose of this work is to support the ongoing experimental program at the Institute of Gas Technology (IGT) and to aid in scale-up of the small laboratory test stand to a commercial-size unit. The annual report reflects the work effort achieved for the reported period. During this period of time, the computational code has been developed step-by-step for each submodel. The computer code was developed to simultaneously solve the energy and momentum equation with variable properties. Experimental work on heat transfer to a single tube was completed, based on the need for validation of the mathematical model. A comparison of the major calculated parameters (pressure drop, gas temperature, heat transfer coefficients, thermal efficiency, and flame location) show very good agreement with IGT experimental data. GRA

N93-24174# Colorado Univ., Boulder.

MATHEMATICAL ANALYSIS OF GASDYNAMIC WAVE INITIATION Final Report, 8 Jul. 1991 - 7 Jul. 1992

D. R. Kassoy and J. Bebernes 15 Sep. 1992 11 p
(Contract DAAL03-91-G-0219)
(AD-A260382; ARO-28728.1-MA) Avail: CASI HC A03/MF A01

Mathematical modeling and analysis are described for studies of the dynamical response of inert or reactive systems to localized rapid power deposition. Theoretical, analytical, and numerical methods are developed to find general properties of nonlinear equation systems and explicit solutions for specific initial-boundary value problems. Emphasis is placed on physical interpretation of mathematical results for the transient evolution of spatially distributed thermal and gasdynamic responses. New results are given for thermal explosion processes, for transient development of shocks and detonations, for the role of nonlinear acoustics in gascompression, and for thermoacoustically induced mass transfer. GRA

N93-24213 Bristol Univ. (England).
SEPARATED FLOW PAST SMOOTH SLENDER BODIES Ph.D. Thesis
Ann Louise Williams 1991 349 p
Avail: Univ. Microfilms Order No. BRDX97391

This dissertation describes an investigation of the separated flow past slender bodies at high angles of attack. Flows of this type occur on aircraft and missile forebodies and can develop large forces which are important when considering stability and control of the vehicle. The objective of this work is to extend the vortex sheet model, which has previously been implemented for slender wings and circular and elliptic cones, to cones of more general cross-section and to non-conical bodies. The cross-sections of the bodies studied here are basically square or triangular, but with rounded corners. The model is inviscid, so the separation positions must be prescribed. Two distinct families of solutions have been identified. For laterally symmetric configurations with symmetric separation positions and no yaw, the first family solutions are symmetric, whereas the second family solutions are asymmetric. For elliptic cones, it is known that cross-section thickness affects the degree of asymmetry of the flow and this represents a mechanism for the control of side forces. Square or triangular cross-sections with rounded corners are of interest to aerodynamicists and have been investigated to assess the effect on asymmetry of making a circular cross-section 'square' or 'triangular'. For 'square' and 'triangular' cones placed either side, or corner on to the flow, results are obtained which enable the effect of cross-section shape on the degree of asymmetry to be assessed. A non-conical vortex sheet model has been developed for the first time for separation from a smooth body. Previously a non-conical line-vortex model was implemented, however lack of representation of vorticity near the separation line limits the applicability of the results. The solution procedure for the non-conical problem consists of a downstream-marching scheme starting from a known solution at the nose. Starting solutions are available if the flow at the nose is assumed conical. With symmetry enforced, solutions have been calculated far downstream, however progress for asymmetric solutions has been more limited. In the asymmetric case the vortex sheet develops inflexions which cause the solution procedure to fail. The non-conical formulation also permitted a stability analysis to be carried out for conical line-vortex solutions, which show that where asymmetric solutions exist they are stable and the corresponding symmetric solutions are unstable. Dissert. Abstr.

N93-24246# Michigan Univ., Ann Arbor. Gas Dynamics Labs.
HIGH RESOLUTION MEASUREMENTS OF MIXING AND REACTION PROCESSES IN TURBULENT FLOWS Annual Report, 1 Oct. 1991 - 31 Sep. 1992
Werner J. Dahm 10 Nov. 1992 34 p
(Grant AF-AFOSR-0541-89)
(AD-A259952; AFOSR-93-0029TR) Avail: CASI HC A03/MF A01

High resolution multi-dimensional imaging measurements were reported of the detailed structure of mixing and combustion processes in turbulent flows. These measurements are unique because they provide the first fully-resolved quantitative data on scalar dissipation rate field structure in turbulent reacting flows. These molecular mixing rate data were coupled with a two-parameter non-equilibrium reaction chemistry formulation to generate instantaneous maps of combustion species concentration and reaction rate fields in turbulent flames under varying degrees of chemical non-equilibrium. Results showed that the reaction zone structure transitioned smoothly from a thin layer-like structure to broad distributed reaction zones as the flame extinction limit was approached. Additionally, fully-resolved four-dimensional spatio-temporal imaging measurements were used to measure the larger scale topology of these scalar dissipation layers. Results showed that the distribution of layer separations is very nearly lognormal. This finding verified a recent analytical model of the multiplicative character of the repeated stretching and folding processes leading to this layer-like structure in the scalar dissipation fields in turbulent flows. This model, coupled with this two-parameter non-equilibrium reaction chemistry formulation, provides a simple approach for predicting the fine structure of molecular mixing and non-equilibrium reaction chemistry in turbulent combustion. GRA

N93-24259# Stanford Univ., CA. Dept. of Mechanical Engineering.
COLLABORATIVE TESTING OF TURBULENCE MODELS Final Report, 23 Jan. 1990 - 31 Jul. 1992
P. Bradshaw 23 Dec. 1992 45 p
(Contract ARO-MIPR-124-90; AF-AFOSR-0154-90)
(AD-A260277; ARO-27625.2-EG) Avail: CASI HC A03/MF A01

This project, funded by AFOSR, ARO, NASA, and ONR, was run by the writer with Profs. Brian E. Launder, University of Manchester, England, and John L. Lumley, Cornell University. Statistical data on turbulent flows, from lab. experiments and simulations, were circulated to modelers throughout the world. This is the first large-scale project of its kirld to use simulation data. The modelers returned their predictions to Stanford, for distribution to all modelers and to additional participants ('experimenters')--over 100 in all. The object was to obtain a consensus on the capabilities of present-day turbulence models and identify which types most deserve future support. This was not completely achieved, mainly because not enough modelers could produce results for enough test cases within the duration of the project. However, a clear picture of the capabilities of various modeling groups has appeared, and the interaction has been helpful to the modelers. The results support the view that Reynolds-stress transport models are the most accurate. GRA

N93-24274# Missouri Univ., Rolla.
THE 12TH SYMPOSIUM ON TURBULENCE Report, 1 Jun. 1990 - 31 May 1992
X. B. Reed, Jr. 19 Nov. 1992 16 p Symposium held in Rolla, MO, 24-26 Sep. 1990
(Contract N00014-90-J-4037)
(AD-A260353) Avail: CASI HC A03/MF A01

The highlights of the technical program were the following: vortical structures and their central role in boundary layer turbulence; the models of free shear dynamics; PDF methods for turbulent flows; and new developments in understanding supersonic turbulent boundary layers. GRA

N93-24282# Naval Postgraduate School, Monterey, CA.
CONVECTIVE HEAT TRANSFER FROM DISCRETE HEAT SOURCES IN A LIQUID FILLED VERTICAL CHANNEL M.S. Thesis
Ronald G. Rahall Dec. 1992 71 p
(AD-A260556) Avail: CASI HC A04/MF A01

Natural, mixed and forced convection liquid cooling of discrete heat sources in a vertical channel were investigated experimentally. Ten heat sources were flush mounted to one side of a channel wall, while the opposite wall was unheated. Measurements of heater surface temperatures were made for a channel Reynolds number range of 0 - 1700 and heat flux range of 1050 - 4500 W/m(exp 2). In the mixed convection regime, both aiding and opposed flow were examined. Temperature patterns on the heated surface were visualized using liquid crystal. GRA

N93-24311# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
THE EFFECTS OF THREE-DIMENSIONAL IMPOSED DISTURBANCES ON BLUFF BODY NEAR WAKE FLOWS Annual Report, 1 Oct. - 30 Sep. 1992
Albin A. Szewczyk 30 Sep. 1992 7 p
(Contract N00014-90-J-4083)
(AD-A259501) Avail: CASI HC A02/MF A01

We wish to achieve a better understanding of the underlying three-dimensional flow structure in the near wake of a bluff body when subjected to imposed geometrical disturbances. We want to understand the effects of three dimensionality that are characterized by vortex splitting

and looping and how they are related to other wake such as base pressure shedding frequency, wake width and wake formation length. GRA

N93-24428# Lehigh Univ., Bethlehem, PA. Dept. of Mechanical Engineering and Mechanics.

CONTROL OF TWO- AND THREE-DIMENSIONAL WAKE INSTABILITIES FROM BLUFF-BODIES

Donald Rockwell Dec. 1992 8 p

(Contract N00014-90-J-1510)

(AD-A260410) Avail: CASI HC A02/MF A01

The long-range goals of this investigation are to: (1) determine the effects of various active and passive control techniques on the instantaneous and time-averaged structure of the three-dimensional wake of a cylinder at low and high Reynolds number; (2) characterize the unsteady loading on the cylinder, including the phase shifts between the cylinder motion, the forces acting on the cylinder, and the three-dimensional structure of the near-wake; and (3) develop new types of experimental techniques, focusing on high-image-density particle image velocimetry (PIV), image processing and pattern recognition, and methods of instantaneous force measurement. GRA

N93-24434# Argonne National Lab., IL.

DETERMINATION AND CHARACTERISTICS OF THE TRANSITION TO TWO-PHASE SLUG FLOW IN SMALL CHANNELS

M. W. Wambsganss, J. A. Jendrzejczyk, and D. M. France (Illinois Univ., Chicago.) 1992 36 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA, 8-13 Nov. 1992

(Contract W-31-109-eng-38)

(DE93-004250; ANL/CP-76261; CONF-921110-36) Avail: CASI HC A03/MF A01

Two-phase pressure drop was measured in a small horizontal rectangular channel (hydraulic diameter = 5.44 mm). The two-phase fluid was an air/water mixture at atmospheric pressure tested over a mass flux range of 50 to 2000 kg/m(sup 2) s. Two-phase flow patterns were identified and an objective method was found for determining the flow pattern transition from bubble or plug flow to slug flow. The method is based on an RMS pressure measurement. In particular, it is shown that the transition is accompanied by a clear and abrupt increase in the RMS pressure when plotted as a function of mass quality. Use of the RMS pressure as a two-phase flow pattern transition indicator is shown to have advantages over pressure-versus-time trace evaluations reported in the literature. The transition is substantiated by a clear local change in slope in the curve of two-phase pressure drop plotted as a function of either Martinelli parameter or mass quality. For high mass fluxes, the change in slope is distinguished by a local peak. Some degree of substantiation was found in previous work for both of the results (the RMS pressure change and the local pressure drop change) at the transition to slug flow. DOE

N93-24487# Aeritalia S.p.A., Pomigliano D'Arco (Italy). Viale dell'Aeronautica.

A METHOD FOR THE ANALYSIS OF COMPLEX CONFIGURATION THREE DIMENSIONAL INTERNAL VORTICES BASED ON THE SOLUTION OF EULER EQUATIONS [UN METODO PER L'ANALISI DI CAMPI TRIDIMENSIONALI VORTICOSI INTORNO A CONFIGURAZIONE COMPLESSE BASATO SULLA RISOLUZIONE DELLE EQUAZIONI DU EULERO]

A. Amendola, R. Tognaccini, and P. L. Vitagliano 1989 11 p In ITALIAN Presented at Associazione Italiana di Aeronautica e Astronautica 10th Congresso Nazionale, Pisa, Italy, 16-20 Oct. 1989

(ETN-93-93701) Avail: CASI HC A03/MF A01

A computation program for subsonic and transonic analysis of complex aerodynamic configurations is presented. The flow model is based on Euler equations, and it is possible to introduce the propellor effect by means of boundary conditions (actuator disk model), so that the system is particularly suited to vortex fields. The software components are as follows: interactive graphics package for topological decomposition; computational grid generator; resolution of the equations of motion; and flow visualization. Application examples of industrially interesting configurations are presented, and future developments are outlined. ESA

N93-24494*# Institute for Computer Applications in Science and Engineering, Hampton, VA.

ROLE OF ACOUSTICS IN FLAME/VORTEX INTERACTIONS Final Report

T. L. Jackson (Old Dominion Univ., Norfolk, VA.), Michele G. Macaraeg, and M. Y. Hussaini Washington Feb. 1993 37 p Submitted for publication Sponsored by NASA. Langley Research Center

(Contracts NAS1-18605; NAS1-19480; AF-AFOSR-0180-91; RTOP 505-90-52-01)

(NASA-CR-191429; NAS 1.26:191429; ICASE-93-4) Avail: CASI HC A03/MF A01

The role of acoustics in flame/vortex interactions is examined via asymptotic analysis and numerical simulation. The model consists of a one-step, irreversible Arrhenius reaction between initially unmixed species occupying adjacent half-planes which are allowed to mix and react by convection and diffusion in the presence of an acoustic field or a time-varying pressure field of small amplitude. The main emphasis is on the influence of the acoustics on the ignition time and flame structure as a function of vortex Reynolds number and initial temperature differences of the reactants. Author

N93-24505# Northwestern Univ., Evanston, IL. Dept. of Engineering Sciences and Applied Mathematics.

EFFECTS OF CAPILLARITY ON MICROSCOPIC FLOW IN POROUS MEDIA

M. J. Miksis Jan. 1993 10 p

(Contract DE-FG02-88ER-13927)

(DE93-007626; DOE/ER-13927/5) Avail: CASI HC A02/MF A01

The objective of this proposal is to study the effects of capillarity on the motion of a fluid interface and to apply these results to flow in porous media. Here we report on several problems considered during this, the second year of the grant. In particular we have developed a numerical code to study the dynamics of a gas bubble in a pore in order to examine the fundamental mechanism for the generation of a foam in a porous material. Additionally, we have started an investigation of the stability of a foam lamella in order to understand the stability of foam flow in a porous material, and we have derived systematically a slip coefficient for flow over a rough surface, e.g., as in a pore. Finally, we report on work on several other problems. DOE

N93-24526*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.

HYPERSONIC SHOCK/BOUNDARY-LAYER INTERACTION DATABASE (Diskette Supplement)

Gary S. Settles and Lori J. Dodson Apr. 1991 157 p Diskette supplement: IBM compatible 5.25-inch DSHD

(Grant NAG2-565; RTOP 505-59-40)

(NASA-CR-177577; NAS 1.26:177577; PSU-ME-90/91-003; NONP-Suppl-DK-93-159789) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A13

The present database collection and assessment effort, with respect to shock/boundary layer interactions, include both supersonic (M 3 and above) and hypersonic data, both two-dimensional (2-D) and three-dimensional (3-D) data, and both unseparated and separated turbulent boundary layer cases (though the emphasis is on the latter). Consideration not only includes perfect-gas behavior, but also real gases and (where appropriate) chemically-reacting flows. It is recognized, however, that very little data of the latter two types exist within the chosen subject area. A floppy disk containing data files of the hypersonic shock/boundary layer interaction database is included. Author

N93-24531*# Lockheed-Georgia Co., Marietta.

EXPERIMENTAL STUDY OF THE SEPARATING CONFLUENT BOUNDARY-LAYER. VOLUME 2: EXPERIMENTAL DATA. APPENDICES A-E: DATA SUPPLEMENT (Diskette)

J. A. Braden, R. R. Whipkey, G. S. Jones, and D. E. Lilley Mar. 1983 Diskette: IBM compatible 5.25-inch DSHD

(Contract NAS1-16028)

(NASA-CR-166018-Suppl; NAS 1.26:166018-Suppl; LG82ER0184-Suppl; NONP-Suppl-DK-93-159798) Avail: Issuing Activity (Center for AeroSpace Information) DK A01

A supplement to NASA document N84-20481 is presented in the form

of appendices A, B, C, D, and E, which contain the LV-derived boundary-layer and wake data for approximately 30,000 combinations of airfoil geometric locations and configurations in the form of velocity vectors, turbulence intensities, and Reynolds shear stresses. The appendices are provided on a floppy disk. The original document discussed an experimental low speed study of the separating confluent boundary layer on a NASA GAW-1 high lift airfoil. CASI

N93-24533*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER FLOW OVER A SPINNING CYLINDER (Diskette Supplement)

David M. Driver and Sheshagiri K. Hebbar (Naval Postgraduate School, Monterey, CA.) Dec. 1991 88 p Diskette supplement: IBM compatible 3.5-inch DSDD

(RTOP 505-60-11)

(NASA-TM-102240; A-89258; NAS 1.15:102240;

NONP-Suppl-DK-93-159800) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A09

Two sets of experiments are reported for a three-dimensional turbulent boundary-layer flow over a spinning cylinder, with and without a pressure gradient, which was produced by a forward-facing-step obstruction. Additional measurements are reported for two-dimensional flow over the same cylinder (nonspinning), with and without a pressure gradient. The data are presented in tables. The cylinder, which is axially aligned with the flow, contains three sections: an upstream stationary section, a central spinning section (where the flow develops a lateral component), and a downstream stationary section (where the flow's lateral component decays). Measurements were acquired primarily on the downstream stationary section and include all 3 components of mean velocity, all 6 Reynolds stresses, and 10 triple-velocity-product correlations. Surface pressure and skin friction were also measured. The data indicate that Reynolds shear stress is not simply proportional to mean-flow strain rate and that significant anisotropies develop in eddy viscosities. Also, the streamwise pressure gradient is seen to alter streamwise velocity and Reynolds stress without significantly affecting transverse velocity and Reynolds stress. Calculations using a Reynolds-stress equation model predict the mean flow reasonably well. Both corrected (for possible velocity biases) and uncorrected data are reported and stored on the floppy disk attached so that when future research on velocity bias is available an informed decision can be made as to which of the data sets to use. Author (revised)

N93-24534*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AN EXPERIMENTAL INVESTIGATION OF A SUPERCRITICAL AIRFOIL AT TRANSONIC SPEEDS (Diskette Supplement)

G. G. Mateer, H. L. Seegmiller, L. A. Hand, and J. Szodruch (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany.) Jul. 1992 56 p Diskette supplement: IBM compatible 3.5-inch diskette in ASCII format

(RTOP 505-59-40)

(NASA-TM-103933; A-92089; NAS 1.15:103933;

NONP-Suppl-DK-93-159801) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A09

Detailed experimental data were obtained on a supercritical airfoil and in the surrounding flowfield. Surface pressures were measured on both the model and wind-tunnel walls. The velocity field above the airfoil and the field in its wake was documented using a laser Doppler velocimeter. The data illustrate the effect of Mach number and angle of attack on the flow over the airfoil. Angles of attack ranged from 0.5 to 1.5 degrees and the Mach number was varied from 0.73 to 0.8. These variations were sufficient to provide separated and attached flows on the airfoil that were not time dependent. The profile drag was determined via non-intrusive measurements. The data are also on a 3.5-inch diskette included and are available though E-mail. Author (revised)

N93-24537*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INTERSECTING SHOCK-WAVE/TURBULENT BOUNDARY-LAYER INTERACTIONS AT MACH 8.3 (Diskette Supplement)

M. I. Kussoy (Eloret Corp., Palo Alto, CA.) and K. C. Horstman (Eloret Corp., Palo Alto, CA.) Feb. 1992 49 p Diskette supplement: IBM compatible 3.5-inch DSHD

(Contract NCC2-452; RTOP 505-59-40)

(NASA-TM-103909; A-92027; NAS 1.15:103909;

NONP-Suppl-DK-93-159251) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A09

Experimental data for two three-dimensional intersecting shock-wave/turbulent boundary-layer interaction flows at Mach 8.3 are presented. The test bodies, composed of two sharp fins fastened to a flat-plate test bed, were designed to generate flows with varying degrees of pressure gradient, boundary-layer separation, and turning angle. The data include surface pressure and heat transfer distributions as well as mean flow-field surveys both in the undisturbed and interaction regimes. The data are presented in a convenient form to be used to validate existing or future computational models of these hypersonic flows. The data are also on a 3.5-inch diskette included and are available through E-mail. Author (revised)

N93-24541*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

EXPERIMENTAL STUDY OF A THREE-DIMENSIONAL SHEAR-DRIVEN TURBULENT BOUNDARY LAYER WITH STREAMWISE ADVERSE PRESSURE GRADIENT (Diskette Supplement)

David M. Driver and James P. Johnston May 1990 263 p Diskette supplement: IBM compatible 5.25-inch diskette

(RTOP 505-60-11)

(NASA-TM-102211; A-89104; NAS 1.15:102211;

NONP-Suppl-DK-93-159790) Avail: Issuing Activity (Center for Aerospace Information) HC/DK A17

The effects of a strong adverse pressure gradient on a three-dimensional turbulent boundary layer are studied in an axisymmetric spinning cylinder geometry. Velocity measurements made with a three-component laser Doppler velocimeter include all three mean flow components, all six Reynolds stress components, and all ten triple-product correlations. Reynolds stress diminishes as the flow becomes three-dimensional. Lower levels of shear stress were seen to persist under adverse pressure gradient conditions. This low level of stress was seen to roughly correlate with the magnitude of cross-flow (relative to free stream flow) for this experiment as well as most of the other experiments in the literature. Variations in pressure gradient do not appear to alter this correlation. For this reason, it is hypothesized that a three-dimensional boundary layer is more prone to separate than a two-dimensional boundary layer, although it could not be directly shown here. None of the computations performed with either a Prandtl mixing length, k-epsilon, or a Launder-Reece-Rodi full Reynolds-stress model were able to predict the reduction in Reynolds stress. A 1.2 MB IBM-format floppy diskette is included. Author (revised)

N93-24542*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DOCUMENTATION OF TWO- AND THREE-DIMENSIONAL SHOCK-WAVE/TURBULENT-BOUNDARY-LAYER INTERACTION FLOWS AT MACH 8.2 (Diskette Supplement)

M. I. Kussoy (Eloret Corp., Palo Alto, CA.) and K. C. Horstman (Eloret Corp., Palo Alto, CA.) May 1991 46 p Diskette supplement: IBM compatible 3.5-inch diskette

(RTOP 505-59-40)

(NASA-TM-103838; A-91069; NAS 1.15:103838;

NONP-Suppl-DK-93-159791) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A09

Experimental data for a series of two-dimensional and three-dimensional shock-wave/turbulent boundary-layer interaction flows at Mach 8.2 are presented. The test bodies, composed of simple geometric shapes fastened to a flat plate test bed, were designed to generate flows with varying degrees of pressure gradient, boundary-layer separation, and turning angle. The data include surface pressure and heat transfer distributions as well as limited mean flow field surveys both in the undisturbed and interaction regimes. The data are presented in a convenient arm to be used to validate existing or future computational models of these hypersonic flows. Additional data are on a computer disk which is included.

Author (revised)

N93-24577# Creare, Inc., Hanover, NH.
NUMERICAL MODELING OF FLUIDIC FLOW METERS Final Report, Sep. 1987 - Feb. 1989
D. Choudhury and B. R. Patel May 1992 47 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5086-271-1269)
(PB93-124139; CREARE-TM-1475-C; GRI-92/0060.2) Avail: CASI HC A03/MF A01

The transient fluid flow in fluidic flow meters has been modeled using Creare.x's flow modeling computer program FLUENT/BFC that solves the Navier-Stokes equations in general curvilinear coordinates. The numerical predictions of fluid flow in a fluidic flow meter have been compared with the available experimental results for a particular design, termed the PC-4 design. Overall flow structures such as main jet bending, and primary and secondary vortices predicted by FLUENT/BFC are in excellent agreement with flow visualization results. The oscillation frequencies of the PC-4 design have been predicted for a range of flow rates encompassing laminar and turbulent flow and the results are in good agreement with experiments. The details of the flow field predictions reveal that an important factor that determines the onset of oscillations in the fluidic flow meter is the feedback jet momentum relative to the main jet momentum. The insights provided by the analysis of the PC-4 fluidic flow meter design have led to an improved design. The improved design has sustained oscillations at lower flow rates compared with the PC-4 design and has a larger rangeability.
Author

N93-22833# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Heat Rejection Section.
ENGINEERING ASPECTS OF TWO-PHASE FLOW SYSTEMS FOR HEAT TRANSPORT
W. Supper *In its* Fluids in Space Jun. 1992 p 47-59 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22835# Naples Univ. (Italy). Ist. di Aerodinamica.
NATURAL AND MARANGONI CONVECTION IN TWO SUPERPOSED IMMISCIBLE LIQUID LAYERS WITH HORIZONTAL HEATING
L. G. Napolitano, A. Viviani, and R. Savino *In* ESA, Fluids in Space Jun. 1992 p 79-108 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22841# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).
FLUID MECHANICS APPLICATIONS FOR THE DESIGN AND TEST OF THE SURFACE TENSION TANK OST-2
G. Netter (Erno Raumfahrttechnik G.m.b.H., Bremen, Germany.) and M. Dreyer (Bremen Univ., Germany.) *In* ESA, Fluids in Space Jun. 1992 p 179-193 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22844# Bremen Univ. (Germany). Center of Applied Space Technology and Microgravity.
HEAT AND MASS TRANSFER IN POLYPHASE FLOWS
H. J. Rath and A. Delgado *In* ESA, Fluids in Space Jun. 1992 p 225-243 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22845# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.
RESEARCHES AND DEVELOPMENTS ON TYPICAL THERMAL TECHNOLOGIES FOR SPACE APPLICATIONS
M. Dubois and S. VanOost *In* ESA, Fluids in Space Jun. 1992 p 245-259 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22846# MATRA Marconi Space, Toulouse (France).
FIRST RESULTS OF A FREON 12 CAPILLARY PUMPED LOOP
M. Feuillatre, T. Maciaszek (Centre National d'Etudes Spatiales, Toulouse, France.), C. Butto (Toulouse Univ., France.), V. Platel (Toulouse Univ., France.), J. Y. Grandpeix (Toulouse Univ., France.), and O. Fudym (Toulouse Univ., France.) *In* ESA, Fluids in Space Jun. 1992 p 261-267 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22855# Battelle Inst., Frankfurt am Main (Germany).
OSCILLATIONS OF FINITE LIQUID COLUMNS
Dieter Langbein *In* ESA, Fluids in Space Jun. 1992 p 419-442 (For primary document see N93-22830 08-29)
(Contract BMFT-QV-8920)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22856# Naples Univ. (Italy). Ist. di Aerodinamica.
SURFACE TENSION AND BUOYANCY DRIVEN STOKES FLOW IN CAVITIES
L. G. Napolitano, A. Viviani, and D. Castagnolo *In* ESA, Fluids in Space Jun. 1992 p 443-480 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22857# Institut de Mecanique des Fluides de Marseille (France).
LASER SURFACE TREATMENT: NUMERICAL SIMULATION OF THERMOCAPILLARY FLOW AND FREE SURFACE DEFORMATION
F. D. Cipriani and A. Roux *In* ESA, Fluids in Space Jun. 1992 p 481-488 (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22860# Laboratoire d'Aerothermique du CNRS, Meudon (France).
A METHOD OF MEASURING THE INTERFACIAL TENSION OF TWO LIQUIDS OF THE SAME MASS VOLUME: THE CYLINDRICAL METHOD [UNE METHODE DE MESURE DE LA TENSION INTERFACIALE DE DEUX LIQUIDES DE MEME MASS VOLUMIQUE: LA METHODE DU CYLINDRE]
C. Bisch and I. Martinez (Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain.) *In* ESA, Fluids in Space Jun. 1992 p 517-524 In FRENCH (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22861# Institut National Polytechnique, Grenoble (France). Lab. de Thermodynamique et Physico-Chimie Metallurgiques.
WETTING HYSTERESIS OF TIN ON SILICA SOLID SURFACES OF CONTROLLED PERIODIC ROUGHNESS
V. DeJonghe and D. Chatain *In* ESA, Fluids in Space Jun. 1992 p 525-532 Sponsored by CNES (For primary document see N93-22830 08-29)
(Grant B/BREU-900307-8)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-22864# Toulon Univ. (France).
STUDY OF THE INFLUENCE OF THE WETTABILITY OF A WALL ON A THIN FILM [ETUDE DE L'INFLUENCE DE LA MOUILLABILITE DE LA PAROI SUR LA STABILITE D'UN FILM MINCE]
P. Seppecher *In* ESA, Fluids in Space Jun. 1992 p 553-568 In FRENCH Sponsored by CNES (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24385# Naples Univ. (Italy). Inst. of Aerodynamics.
FLUID SCIENCE USERS REQUIREMENTS
R. Monti and L. Carotenuto (Microgravity Advanced Research and Support Center, Naples, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8):

Utilisation of Earth Orbiting Laboratories Jul. 1992 p 275-280 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N93-22072# Argonne National Lab., IL.
EXPERIMENTAL DEMONSTRATION OF HIGH RESOLUTION THREE-DIMENSIONAL X RAY HOLOGRAPHY
I. McNulty, J. E. Trebes, J. M. Brase, T. J. Yorkey, R. Levesque, H. Szoke (Lawrence Livermore National Lab., CA.), and E. H. Anderson (California Univ., Berkeley. Lawrence Berkeley Lab.) 1992 7 p Presented at the Conference on Physics and Engineering of Advanced Detectors and Collection/Focusing Systems, San Diego, CA, 19-24 Jul. 1992
(Contracts W-31-109-eng-38; W-7405-eng-48)
(DE93-004178; ANL/XFD/CP-76139; CONF-920768-8) Avail: CASI HC A02/MF A01

Tomographic x-ray holography may make possible the imaging of biological objects at high resolution in three dimensions. We performed a demonstration experiment with soft x-rays to explore the feasibility of this technique. Coherent 3.2-nm undulator radiation was used to record Fourier transform holograms of a microfabricated test object from various illumination angles. The holograms were numerically reconstructed according to the principles of diffraction tomography, yielding images of the object that are well resolved in three dimensions. DOE

N93-22326# Los Alamos National Lab., NM.
NONINTRUSIVE TEMPERATURE MEASUREMENTS ON ADVANCED TURBOMACHINERY COMPONENTS
B. W. Noel, W. D. Turley (EG and G Energy Measurements, Inc., Idaho Falls.), and W. Lewis (EG and G Energy Measurements, Inc., Idaho Falls.) 1992 28 p Presented at the Latin American Conference on Turbomachinery, Cuernavaca, Mexico, 15-18 Feb. 1993
(Contract W-7405-eng-36)
(DE93-005478; LA-UR-92-4227; CONF-930249-1) Avail: CASI HC A03/MF A01

A nonintrusive, noncontacting method we developed for temperature measurements in hostile environments is well-suited for measurements on advanced turbine components. The method is not only superior to thermocouples in sufficiently difficult environments, but also is the only known method for making measurements in situations where no form of pyrometry works. We demonstrated the method, which uses laser-induced fluorescence of thermographic phosphors bonded to the component surfaces, on turbine blades and vanes in developmental turbine engines. The method is extendable to the much-higher temperatures expected inside advanced turbomachinery. Of particular note is the adaptability of the method to surface-temperature measurements on ceramics operating at high temperatures. In this temperature range, the ceramics become translucent, and surface emissivity becomes meaningless. We shall discuss the method, its advantages and limitations, recent test results on operating turbine engines, and the extension to ceramic components. DOE

N93-22338# Pacific Northwest Lab., Richland, WA.
COMPARISON OF ANEMOMETERS FOR TURBULENCE CHARACTERIZATION
V. R. Morris, J. C. Barnard, L. L. Wendell, and S. D. Tomich Oct. 1992 9 p Presented at the Windpower 1992, Seattle, WA, 19-23 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004336; PNL-SA-21321; CONF-921049-6) Avail: CASI HC A02/MF A01

During the first phase of the US Department of Energy's turbulence characterization program, important discoveries were made about the field application of propeller-vane and cup anemometers under very turbulent conditions. First, averaged speeds measured by the propeller-vane anemometer were consistently lower than those from the cup anemometer, even though both registered virtually the same during wind-tunnel calibration testing. Second, the propeller-vane anemometers suffered from structural failures much more frequently than the cup anemometers. The difficulties associated with the use of the propeller-vane motivated us to consider the cup anemometer for turbulence measurements. At fast sample rates, the output of the cup anemometer is severely degraded by discretization error that stems from pulse counting demodulation. However, we found that a low-pass Gaussian filter could be applied to the time series of wind speed derived from the cup anemometer to yield time series and frequency spectra that compared very favorably with those obtained from the propeller-vane anemometer. This finding suggests that the cup anemometer may prove to be an inexpensive and rugged sensor appropriate for turbulence measurements for wind-energy applications. DOE

N93-22347*# Teledyne Brown Engineering, Huntsville, AL.
SPACE STATION FURNACE FACILITY PRELIMINARY PROJECT IMPLEMENTATION PLAN (PIP). VOLUME 2, APPENDIX 2 Final Report
John K. Perkey May 1992 189 p Original contains color illustrations
(Contract NAS8-38077)
(NASA-CR-192474; NAS 1.26:192474; Rept-320PLN0006-Vol-2-App-2)
Avail: CASI HC A09/MF A02; 1 functional color page

The Space Station Furnace Facility (SSFF) is an advanced facility for materials research in the microgravity environment of the Space Station Freedom and will consist of Core equipment and various sets of Furnace Module (FM) equipment in a three-rack configuration. This Project Implementation Plan (PIP) document was developed to satisfy the requirements of Data Requirement Number 4 for the SSFF study (Phase B). This PIP shall address the planning of the activities required to perform the detailed design and development of the SSFF for the Phase C/D portion of this contract. Author (revised)

N93-22349*# Teledyne Brown Engineering, Huntsville, AL.
SPACE STATION FURNACE FACILITY CORE. REQUIREMENTS DEFINITION AND CONCEPTUAL DESIGN STUDY. VOLUME 2: TECHNICAL REPORT. APPENDIX 6: TECHNICAL SUMMARY REPORTS Final Report
May 1992 1007 p Original contains color illustrations
(Contract NAS8-38077)
(NASA-CR-192477; NAS 1.26:192477) Avail: CASI HC A99/MF A10; 2 functional color pages

The Space Station Furnace Facility (SSFF) is a modular facility for materials research in the microgravity environment of the Space Station Freedom (SSF). The SSFF is designed for crystal growth and solidification research in the fields of electronic and photonic materials, metals and alloys, and glasses and ceramics and will allow for experimental determination of the role of gravitational forces in the solidification process. The facility will provide a capability for basic scientific research and will evaluate the commercial viability of low-gravity processing of selected technologically important materials. The facility is designed to support a complement of furnace modules as outlined in the Science Capabilities Requirements Document (SCRD). The SSFF is a three rack facility that provides the functions, interfaces, and equipment necessary for the processing of the furnaces and consists of two main parts: the SSFF Core Rack and the two Experiment Racks. The facility is designed to accommodate two experimenter-provided furnace modules housed within the two experiment racks, and is designed to operate these two furnace modules simultaneously. The SCRD specifies a wide range of furnace requirements and serves as the basis for the SSFF conceptual design. SSFF will support automated processing during the man-tended operations and is also designed for crew interface during the permanently manned configuration. The facility is modular in design and facilitates changes as required, so the SSFF is adept to modifications, maintenance, reconfiguration, and technology evolution. Author (revised)

N93-22484*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNIQUES FOR IMPROVING THE ACCURACY OF CYROGENIC TEMPERATURE MEASUREMENT IN GROUND TEST PROGRAMS
Paula J. Dempsey and Richard H. Fabik May 1993 16 p Prepared for presentation at the 39th Aerospace Industries/Test Measurement Symposium, Albuquerque, NM, 3-6 May 1993; sponsored by the Instrument

Society of America
(RTOP 593-21-00)
(NASA-TM-105996; E-7536; NAS 1.15:105996) Avail: CASI HC A03/MF A01

The performance of a sensor is often evaluated by determining to what degree of accuracy a measurement can be made using this sensor. The absolute accuracy of a sensor is an important parameter considered when choosing the type of sensor to use in research experiments. Tests were performed to improve the accuracy of cryogenic temperature measurements by calibration of the temperature sensors when installed in their experimental operating environment. The calibration information was then used to correct for temperature sensor measurement errors by adjusting the data acquisition system software. This paper describes a method to improve the accuracy of cryogenic temperature measurements using corrections in the data acquisition system software such that the uncertainty of an individual temperature sensor is improved from plus or minus 0.90 deg R to plus or minus 0.20 deg R over a specified range. Author (revised)

N93-22491# California Univ., Berkeley. Lawrence Berkeley Lab.
A SPARSE ARCHITECTURE LOW POWER GATED INTEGRATOR FOR USE WITH GERMANIUM GAMMA RAY SPECTROMETERS IN REMOTE GEOCHEMISTRY MEASUREMENTS
N. Madden, D. Landis, R. Adachi, R. Pehl, R. Abott, and E. Stogsdill Oct. 1992 5 p Presented at the Nuclear Science Symposium, Orlando, FL, 26-31 Oct. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004769; LBL-32273; CONF-921005-13) Avail: CASI HC A01/MF A01

Prototypical circuits of a low power gated integrator for use with germanium gamma-ray spectrometers in remote locations have been developed. The gated integrator is constructed from three very simple sub circuits. With a power consumption of less than 250mW the low count rate spectroscopy performance of this gated integrator is comparable to that of a conventional pulse shaping amplifier at energies of 1 MeV and greater. DOE

N93-22598*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ICING RESEARCH TUNNEL ROTATING BAR CALIBRATION MEASUREMENT SYSTEM
Theresa L. Gibson and John M. DeArmon (Sverdrup Technology, Inc., Brook Park, OH.) Mar. 1993 16 p Prepared for presentation at the 39th Aerospace Industries/Test Measurement Symposium, Albuquerque, NM, 3-6 May 1993; sponsored by the Instrument Society of America
(RTOP 505-62-84)
(NASA-TM-106010; E-7539; NAS 1.15:106010) Avail: CASI HC A03/MF A01

In order to measure icing patterns across a test section of the Icing Research Tunnel, an automated rotating bar measurement system was developed at the NASA Lewis Research Center. In comparison with the previously used manual measurement system, this system provides a number of improvements: increased accuracy and repeatability, increased number of data points, reduced tunnel operating time, and improved documentation. The automated system uses a linear variable differential transformer (LVDT) to measure ice accretion. This instrument is driven along the bar by means of an intelligent stepper motor which also controls data recording. This paper describes the rotating bar calibration measurement system. Author

N93-22684 Princeton Univ., NJ.
A BOLOMETRIC RADIOMETER FOR INVESTIGATIONS IN COSMOLOGY Ph.D. Thesis
Gregory A. Wright 1992 144 p
Avail: Univ. Microfilms Order No. DA9235270

This thesis describes the design and construction of a bolometric radiometer operating at a wavelength of 1.2 millimeters. The goal of this experiment is to search for the millimeter wave radiation from primeval galaxies. The instrument's sensitivity, based upon laboratory measurements, is adequate to test models of galaxy formation that have an infrared bright period at high redshift. The bolometer is cooled by an adiabatic demagnetization refrigerator. The construction of the refrigerator, capable of cooling the detector to 50 mK and keeping it cold for over eight hours is detailed. The experiment is installed on the 7 meter radio telescope on Crawford Hill in Holmdel, New Jersey. The design of a feed mirror system compatible with the telescope is described. Particular attention was devoted to minimizing scattering of the beam; all mirrors are offset conics. Operation of the instrument should begin in the fall of 1992. Dissert. Abstr.

N93-22706# California Univ., Berkeley. Lawrence Berkeley Lab.
DESIGN OF HIGH-T(SUB c) BOLOMETERS ON SILICON MEMBRANES FOR A FAR INFRARED IMAGING ARRAY
S. Verghese, P. L. Richards, D. K. Fork (Xerox Palo Alto Research Center, CA.), K. Char (Conductus, Inc., Sunnyvale, CA.), and T. H. Geballe (Stanford Univ., CA.) Sep. 1992 2 p Presented at the 17th Annual Society of Photo-Optical Instrumentation Engineers (SPIE) International Conference on Infrared and Millimeter Wave Sources, Pasadena, CA, 14-18 Dec. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004784; LBL-32951; CONF-921217-2) Avail: CASI HC A01/MF A01

We discuss the design of high-(Tc) superconducting bolometers for use in a far infrared imaging array from wave-lengths 30-100 micron. Useful opportunities exist for imaging and spectroscopy with bolometer arrays made on micro-machined silicon membranes. DOE

N93-22994*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OTV BEARING DEFLECTION INVESTIGATION
B. L. Reimer (Aerojet-General Corp., Sacramento, CA.), R. T. Diepenbrock (Aerojet-General Corp., Sacramento, CA.), and M. G. Millis Apr. 1993 18 p Sponsored by NASA. Lewis Research Center
(Contract F04611-86-C-0010; RTOP 593-12-11)
(NASA-TM-106085; E-7714; NAS 1.15:106085) Avail: CASI HC A03/MF A01

The primary goal of the Bearing Deflectometer Investigation was to gain experience in the use of fiber optic displacement probe technology for bearing health monitoring in a liquid hydrogen turbo pump. The work specified in this Task Order was conducted in conjunction with Air Force Rocket Propulsion Laboratory Contract F04611-86-C-0010. APD conducted the analysis and design coordination to provide a displacement probe design compatible with the XLR-134 liquid hydrogen turbo pump assembly (TPA). Specifications and requirements of the bearing deflectometer were established working with Mechanical Technology Instruments, Inc. (MTI). The TPA design accommodated positioning of the probe to measure outer race cyclic deflections of the pump inlet bearing. The fiber optic sensor was installed as required in the TPA and sensor output was recorded during the TPA testing. Data review indicated that no bearing deflection signature could be differentiated from the inherent system noise. Alternate sensor installations were not investigated, but might yield different results. Author

N93-23083*# Teledyne Brown Engineering, Huntsville, AL.
SPACE STATION FURNACE FACILITY. VOLUME 2: APPENDIX 1: CONTRACT END ITEM SPECIFICATION (CEI), PART 1 Final Report
Craig Seabrook May 1992 117 p
(Contract NAS8-38077)
(NASA-CR-192473; NAS 1.26:192473) Avail: CASI HC A06/MF A02

This specification establishes the performance, design, development, and verification requirements for the Space Station Furnace Facility (SSFF) Core. The definition of the SSFF Core and its interfaces, specifies requirements for the SSFF Core performance, specifies requirements for the SSFF Core design, and construction are presented, and the verification requirements are established. Derived from text

N93-23230# Pennsylvania Univ., Philadelphia.
PYROELECTRIC ANEMOMETERS AND KINETIC CALORIMETERS Annual Report, 1 Apr. 1990 - 30 Mar. 1991
Steven H. Y. Hsieh, Anita Spetz, and Jay N. Zemel Nov. 1991 42 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5089-260-1882)
(PB93-141919; GRI-91/0322) Avail: CASI HC A03/MF A01

The pyroelectric anemometer (PA) is a thermal detector developed at the University of Pennsylvania for monitoring gas flows. The range of the PA has been demonstrated to be quite extraordinary, covering a minimum of five orders of magnitude. The heat requirements for the device are quite minimal (maximum of 20 mW) which insures that the maximum

temperature reached by the 6 mm x 6 mm PA is less than 3 C. As a thermally based flow sensor, the PA is a flexible sensor that can be used in a variety of geometric configurations and placed in various positions in a pipe because of its small physical volume. The goal of this program is to conduct a fundamental investigation on the characteristics and properties of the PA that would establish it as a suitable device for directly monitoring large volume flows in natural gas transmission lines or the smaller flows in the distribution and end user sites. The research also aims to determine if the device can be used as a standard against which other flow monitors can be calibrated. GRA

N93-23452# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical Engineering.

CONSTRUCTION AND EVALUATION OF A METAL ION BIOSENSOR Report, 1 Feb. 1990 - 31 Dec. 1992

Lia Tescione and Georges Belfort 15 Jan. 1993 38 p

(Contract N00014-90-J-1715)

(AD-A259775) Avail: CASI HC A03/MF A01

E. coli, genetically engineered with a mercury(II)-sensitive promoter and the lux genes from Vibrio fischeri, were used as microbial sensors for the detection of mercury. Evaluation of this genetic construction was carried out by determining the effects of various parameters on cell suspensions maintained at constant conditions in a small vessel. The strongest light intensities and quickest induction times occurred with cells in the mid-exponential growth phase maintained at 280 C, concentrated to 1 x 10(exp 9) cells/mL, mixed at very fast speeds, and aerated at 2 vvm (volume of air per volume of culture per minute) during light measurement in the small vessel. The sensitivity of these cells to the mercuric ion lied in the range of 0.02-4 micrometer (4-800 ppb) and the total response time was on the order of one hour, depending on the above parameters. The cells exhibited great specificity for mercury. The cells have almost equal specificity for organic and inorganic form of the mercuric ion and responded more weakly to the mercurous ion. A simple, inexpensive, durable miniature probe was constructed and operated using the optimum parameters found in the small vessel as a guide. The range of sensitivity to the mercuric ion detected in the probe was 0.01-4 micrometer when aeration was provided. GRA

N93-23723 Stanford Univ., CA.

BROADBAND ERBIUM-DOPED FIBER SOURCES FOR THE FIBER-OPTIC GYROSCOPE Ph.D. Thesis

Paul Francis Wysocki 1992 284 p

Avail: Univ. Microfilms Order No. DA9234194

The sensitivity of early fiber-optic gyroscopes (FOG) fell short of the theoretical limit. The use of certain configurations, fiber components, and well designed optical sources can help the FOG reach this limit. Sources for the FOG must be broadband, spatially coherent, and high power. They must produce a mean wavelength which is stable with respect to temperature and feedback from system components. Additionally, they must emit at long wavelengths, where silica fibers are insensitive to radiation induced losses. Two approaches to broadband, 1.55 micron erbium-doped fiber sources for the FOG are considered. The most promising approach is the superfluorescent fiber source (SFS), which utilizes amplification of spontaneous emission in a single pass or in two passes through the fiber, without a resonant cavity. Such sources have produced more than 50 percent conversion of pump photons near 980 nm or 1.48 micron to source photons. Laser diode pumping in these pump bands is explored in detail. Depending on fiber length, pump power, pump wavelength, and SFS configuration, emission bandwidths between 8 and 27 nm are measured. The thermal coefficient of the mean wavelength of the SFS is consistently below 10 ppm/C, and near 0 ppm/C for certain design choices. The pump wavelength and pump power are optimized to minimize the dependence of the mean wavelength on these temperature dependent quantities. The detrimental effects of feedback are reduced through optical isolation and the proper choice of FOG configuration. Issues such as the effects of multiple pump modes and loss mechanisms are treated by use of computer simulations. The broadband Er-doped wavelength-swept fiber laser (WSFL) is presented as an alternative to the SFS. This source utilizes an intracavity acousto-optic modulator to sweep the emission of an Er-doped laser across the gain curve of erbium. Theoretical and measured characteristics of such sources are discussed. Emission bandwidths exceeding 20 nm have been demonstrated. The dynamic response of the WSFL and its coherence in an integrating system has been measured. The WSFL has the potential for higher efficiency and for greater control of the emitted spectrum, but it is more complex than the SFS.

Dissert. Abstr.

N93-23731*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

CHARACTERIZING THE UNCERTAINTY IN HOLDDOWN POST LOAD MEASUREMENTS

J. A. Richardson (Alabama Univ., Tuscaloosa.) and J. S. Townsend Mar. 1993 32 p

(NASA-TP-3332; M-715; NAS 1.60:3332) Avail: CASI HC A03/MF A01

In order to understand unexpectedly erratic load measurements in the launch-pad supports for the space shuttle, the sensitivities of the load cells in the supports were analyzed using simple probabilistic techniques. NASA engineers use the loads in the shuttle's supports to calculate critical stresses in the shuttle vehicle just before lift-off. The support loads are measured with 'load cells' which are actually structural components of the mobile launch platform which have been instrumented with strain gauges. Although these load cells adequately measure vertical loads, the horizontal load measurements have been erratic. The load measurements were simulated in this study using Monte Carlo simulation procedures. The simulation studies showed that the support loads are sensitive to small deviations in strain and calibration. In their current configuration, the load cells will not measure loads with sufficient accuracy to reliably calculate stresses in the shuttle vehicle. A simplified model of the holddown post (HDP) load measurement system was used to study the effect on load measurement accuracy for several factors, including load point deviations, gauge heights, and HDP geometry. Author (revised)

N93-24172# Department of Health and Human Services, Washington, DC.

HIGH RESOLUTION DIGITAL THERMOMETER Patent Application

Walter S. Friauf, Thomas R. Clem, and Robert L. Berger 5 Feb. 1992 17 p

(PAT-APPL-7-831-603; PB93-100618) Avail: CASI HC A03/MF A01

A high resolution digital thermometer is disclosed. The thermometer is capable of measuring temperature differences on the order of several micro-degrees centigrade. The device includes a bridge circuit having two thermistors in series. An output of the bridge circuit feeds a signal to an analog-to-digital converter via a high gain amplifier. A computer maintains the balance of the bridge circuit to avoid a situation wherein the range of the analog-to-digital convertor would be exceeded. Because the present invention utilizes two thermistors between which temperature differences are measured, the present invention is particularly advantageous when the two thermistors are in reference and test positions in apparatus for chemical and/or biochemical analysis. For example, in the case of chemical analyzers, one of the thermistors may be positioned in thermal contact with a reaction mixture of interest while the other thermistor may be maintained in thermal contact with a standard or reference solution. GRA

N93-24219# Department of the Navy, Washington, DC.

CONSTANT FALSE PROBABILITY DATA FUSION SYSTEM Patent Application

Robert J. Pawlak, inventor (to Navy) 6 Nov. 1992 15 p

(AD-D015624; US-Patent-Appl-SN-972339; Navy-Case-73934) Avail: CASI HC A03/MF A01

A system for determining whether a given phenomenon has occurred based on multiple sensor decisions is provided. Each sensor samples input data and attempts to decide if the given phenomenon exists. These sensor decisions are provided to the data fusion processor. The data fusion processor uses a sum of the sensor decisions multiplied by a logarithmic gain indicating the relative reliability of each sensor to generate a test existence metric. The test existence metric is compared to two threshold limits. The results of this comparison are used to provide a final decision indicating the existence of the given phenomenon. An optimization is used to determine the threshold values used in the threshold table to guarantee that the false alarm rate and the data fusion processor is constant, even in cases where data from some sensor is missing. GRA

N93-24289# National Research Council of Canada, Boucherville (Quebec). Industrial Materials Inst.
CALIBRATION OF A STANDARD TRANSDUCER USING A LASER INTERFEROMETER (TTCP CALIBRATION ROUND-ROBIN)
Andre Moreau 21 Sep. 1992 19 p
(NRC-34387; IMI92RIS-11731-1057-G; CTN-93-60707) Avail: CASI HC A03/MF A01

A 10-MHz piezoelectric transducer with a half-inch diameter element and square gold target of 4.0 mm on a side was used in an interlaboratory project which consisted of measuring the amplitude of vibration of a standard transducer using a laser interferometer. The work should lead to the establishment of a reproducible procedure for the calibration of laser interferometric systems used for displacement measurements. The experimental setup included a pulse/frequency generator for generating continuous excitation and a heterodyne Michelson interferometer with associated electronics. Three calibration methods were compared. The acoustic amplitude was measured as a function of horizontal position. The measurement error on the acoustic amplitude of a particular data point is estimated at + or - 1 picometer. The reproducibility agrees with the estimated measurement errors. Acoustic amplitude was also studied as a function of excitation voltage. To reduce the large variability in acoustic amplitude with position on the transducer surface, a special transducer assembly with reduced internal reflections was designed; preliminary tests show amplitude could be made uniform to within 10-20 percent over distances of several mm. This could probably be improved with further work. CISTI

N93-24609 Alberta Univ., Edmonton. Dept. of Electrical Engineering.
MICROELECTRONIC AND MICROMECHANICAL SENSORS AND ACTUATORS IN CMOS TECHNOLOGY: A NOVEL SCHEME TOWARD S REGULARIZATION AND INTEGRATION Ph.D. Thesis
Meenakshinathan Parameswaran Edmonton, Alberta Univ. of Alberta 1990 143 p
(ISBN-0-315-60192-2; CTN-93-60646) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC

Inherent features of commercial complementary metal oxide semiconductor (CMOS) technology have been found to be ideally suited for microsensor fabrication. Based on these features, a special sensor layout design procedure has been introduced to achieve complete compatibility with the CMOS technology without altering any of its process sequences. Under this scheme, fabrication of sensors and actuators is possible using only a layout design step and a single post-processing step, eliminating the need for customized fabrication and establishing a direction for regularizing sensor fabrication as it exists in current IC technology. Realization of integrated sensor systems with on-chip electronics becomes readily feasible since the circuit forming capabilities of the CMOS process remain unaffected. Several devices have been successfully fabricated and tested using this scheme, including integrated humidity sensors and micromechanical structures. Functional devices such as gas flow sensors, radiation sources and electrothermal microactuators have also been realized. The on-chip circuit integration capabilities have been demonstrated by various designs and tests. A simple analytical scheme has been developed to model the thermally isolated micromechanical structures, and modelling results are compared to experimental results. Author (CISTI)

N93-24610 Alberta Univ., Edmonton. Dept. of Electrical Engineering.
THE SSIMT: A CMOS BASED MAGNETIC SENSOR Ph.D. Thesis
Tom Smy Edmonton, Alberta Univ. of Alberta 1990 165 p
(ISBN-0-315-60334-8; CTN-93-60647) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, J8X 3X2, Canada, HC

The experimental analysis and an analytical model of a novel microelectronic magnetic sensor are presented. This device is called a suppressed sidewall injection magneto transistor (SSIMT) and is manufactured using standard CMOS technology. The SSIMT has produced the highest sensitivities reported for a linear magneto transistor. The analytical model, based on the assumption of the dominance of carrier deflection as the operating mechanism, successfully predicts the bias dependence of the SSIMT and provides considerable insight into the physical cause of the very high measured sensitivities. Various devices are characterized experimentally and the SSIMT is operated under two different biasing conditions. The SSIMT is systematically compared to a simpler, more traditional magneto transistor in order to determine the effect of its unique structure on the magnetic behavior of the collector currents. The structure of the SSIMT provides an opportunity for analyzing the relative roles, in the magnetic operation of the device, of simple current deflection and the modulation of the emitter injection by a Hall field in the base region. An experimental study of the two effects determines carrier deflection to be the dominant mechanism of magnetic operation. Author (CISTI)

N93-24650# LASIRIS, Inc., Saint-Laurent (Quebec).
DESIGN AND FABRICATION OF DAMMANN GRATINGS TO ILLUMINATE A TIME-INTEGRATING CORRELATOR Final Technical Report
Alain Beauregard Aug. 1991 14 p
(Contract DSS-W7714-1-9515/01-ST)
(CTN-93-60700) Avail: CASI HC A03/MF A01

Dammann gratings are a type of binary phase computer generated hologram with a periodic fringe structure. Work was carried out to design and fabricate a Dammann grating to be used as a precision beamsplitter for the illumination of a time integrating correlator. The production process is described in three steps: design of the diffractive structure; recording of the diffractive structure by electron beam writing; and recording of the Dammann gratings by micro lithographic techniques. The optimal design of the grating features was determined by numerical solution. It was determined that the best solution was a single transition period with exact phase inversion; since the grating period was 10.2 microns, the feature width was 5.1 microns. Taking into account the refractive index of the photoresist layer, the height of the feature was calculated at 0.49 microns. In recording the grating, parameters such as exposure time, developer composition, development temperature, and etching time had to be adjusted to achieve a satisfactory grating profile. The optical performances of the final gratings were determined and the overall specifications were met, except for diffraction efficiencies of the 0 and + or - 2 orders which were slightly more intense than expected. There seems to be a practical limitation in this case. CISTI

N93-22021# GEC Avionics Ltd., Rochester (England). Guidance Systems Div.
INITIAL TRIALS RESULTS FOR IMAGE STABILISATION USING A RUGGED LOW NOISE GYROSCOPE
D. G. Harris *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 7 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A02/MF A02

N93-22201*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A MODULAR, PROGRAMMABLE MEASUREMENT SYSTEM FOR PHYSIOLOGICAL AND SPACEFLIGHT APPLICATIONS
John W. Hines, Robert D. Ricks (Sverdrup Technology, Inc., Moffett Field, CA.), and Christopher J. Miles (Sverdrup Technology, Inc., Moffett Field, CA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 485-493 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22202*# Sverdrup Technology, Inc., Bay Saint Louis, MS.
PREDICTIVE SENSOR METHOD AND APPARATUS
Vivien J. Cambridge and Thomas L. Koger *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 494-500 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22203*# Sverdrup Technology, Inc., Bay Saint Louis, MS. Engineering and Science Dept.
ATTIRE (ANALYTICAL TOOLS FOR THERMAL INFRARED ENGINEERING): A SENSOR SIMULATION AND MODELING PACKAGE
S. Jaggi *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 501-519 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

N93-22783# Litton Guidance and Control Systems, Woodland Hills, CA.
AN OVERVIEW OF OPTICAL GYROSCOPES FOR NAVIGATION
J. G. Mark and D. A. Tazartes *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 9 p (For primary document see N93-22780 08-04)
Copyright Avail: CASI HC A02/MF A02

N93-22784# Delco Electronics, Goleta, CA.
HEMISPHERICAL RESONATOR GYRO: PRINCIPLE, DESIGN, AND PERFORMANCE
W. W. Stripling and John R. Baskett *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 6 p (For primary document see N93-22780 08-04)
Copyright Avail: CASI HC A02/MF A02

N93-22785# LITEF, Freiburg (Germany).
FIBER OPTIC GYROS AND SYSTEMS
H.-J. Bueschelberger and E. Handrich *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 13 p (For primary document see N93-22780 08-04)
Copyright Avail: CASI HC A03/MF A02

N93-22786# Sextant Avionique, Valence (France).
SILICON ACCELEROMETER FOR AHRS AND HYBRID NAVIGATION SYSTEMS [ACCELEROMETRE SILICIUM POUR AHRS ET SYSTEMES HYBRIDES DE NAVIGATION]
J. Leclerc, A. Defosse, and O. Lefort *In* AGARD, Integrated and Multi-Function Navigation Nov. 1992 5 p In FRENCH (For primary document see N93-22780 08-04)
Copyright Avail: CASI HC A01/MF A02

N93-22858# Bremen Univ. (Germany). Center of Applied Space Technology and Microgravity.
INVESTIGATION OF HOT WIRE ANEMOMETERS AT VERY LOW VELOCITIES UNDER MICROGRAVITY
F. R. Stengele, A. Delgado, and H. J. Rath *In* ESA, Fluids in Space Jun. 1992 p 489-500 Sponsored by BMFT (For primary document see N93-22830 08-29)
Copyright Avail: CASI HC A03/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N93-22044# Los Alamos National Lab., NM.
EXCIMER LASER SURFACE MODIFICATION: PROCESS AND PROPERTIES
T. R. Jervis, M. Nastasi, and J. P. Hirvonen 1992 13 p Presented at the Materials Research Society Meeting, Pittsburgh, PA, 3 Nov. - 4 Dec. 1992
(Contract W-7405-eng-36)
(DE93-003726; LA-UR-92-3406; CONF-9211127-1) Avail: CASI HC A03/MF A01

Surface modification can improve materials for structural, tribological, and corrosion applications. Excimer laser light has been shown to provide a rapid means of modifying surfaces through heat treating, surface zone refining, and mixing. Laser pulses at modest power levels can easily melt the surfaces of many materials. Mixing within the molten layer or with the gas ambient may occur, if thermodynamically allowed, followed by rapid solidification. The high temperatures allow the system to overcome kinetic barriers found in some ion mixing experiments. Alternatively, surface zone refinement may result from repeated melting-solidification cycles. Ultraviolet laser light couples energy efficiently to the surface of metallic and ceramic materials. The nature of the modification that follows depends on the properties of the surface and substrate materials. Alloying from both gas and predeposited layer sources has been observed in metals, semiconductors, and ceramics as has surface enrichment of Cr by zone refinement of stainless steel. Rapid solidification after melting often results in the formation of nonequilibrium phases, including amorphous materials. Improved surface properties, including tribology and corrosion resistance, are observed in these materials. DOE

N93-22046# Illinois Univ., Chicago. Lab. for Atomic, Molecular, and Radiation Physics.
MOLECULAR DESIGN CONCEPT FOR X RAY LASER RESEARCH
C. K. Rhodes, T. S. Luk, A. McPherson, and K. Boyer 10 Dec. 1992 16 p
(Contract DE-FG02-91ER-12108)
(DE93-004561; DOE/ER-12108/2) Avail: CASI HC A03/MF A01

The goal of this program is the construction of an x-ray laser in the kilovolt regime. Recent experimental results indicate that a new technique for the generation of strong amplification of x-ray wavelengths is feasible. It involves the combination of (1) a new ultrahigh brightness subpicosecond laser technology and (2) a recently discovered unique mode of strong-field interaction, particularly applicable to molecules. A concept of molecular x-ray design emerges from the considerations which matches the mode of excitation to the structure of the molecular system. The molecular approach enables the combination of very highly electronically excited conditions with an environment characteristic of dense cold matter, a general situation exceptionally conducive to x-ray amplification. Both high efficiency and wavelength tunability are intrinsic features of this method. Recent results discussed are revealing important characteristics of the molecular strong-field coupling pertinent to this goal. A continued program of research is proposed to evaluate this method for the production of x-ray amplification in the kilovolt region. DOE

N93-22327# Lawrence Livermore National Lab., CA.
ELECTRO-OPTIC FRAME PHOTOGRAPHY WITH PULSED RUBY ILLUMINATION
L. L. Shaw, S. A. Muelder, A. T. Rivera, J. L. Dunmire, and R. D. Breithaupt 11 Nov. 1992 16 p Presented at the 20th International Congress on High Speed Photography and Photonics, Victoria, British Columbia, 25-26 Sep. 1992
(Contract W-7405-eng-48)
(DE93-005819; UCRL-JC-112232; CONF-9209188-7) Avail: CASI HC A03/MF A01

By combining the attributes of electro-optic shuttering and pulsed laser illumination in a large format camera system, we have developed a multi-frame image converter camera with a laser illuminator that produces sequential photographs of fast phenomena with very high resolution. The combination of the large size image plane (75 mm), short exposure time per frame (minimum 12-15 ns), and monochromatic laser illumination provides clear, sharp, front-lit images of surfaces and shapes with no degradation by luminous air shocks or motion blur. The unique modular design of the camera and the laser allow for a variety of configurations and applications. The current camera system produces eight independent pictures or four stereo pairs. A Q-switched ruby laser with multiple pulse capability provides individual illumination for each frame. This system has photographed a variety of fast phenomena including the first stereo sequential photographs of the initial formation and early time history of high velocity shaped-charge jets. DOE

N93-22328# Lawrence Livermore National Lab., CA.
HIGH-POWER OPTICAL COATINGS FOR A MEGA-JOULE CLASS ICF LASER
M. R. Kozlowski, I. M. Thomas, J. H. Campbell, and F. Rainer Nov. 1992 17 p Presented at the Society of Photo Optical Instrumentation Engineers (SPIE/EOS) International Symposium on Optical Design Systems, Berlin, Germany, 14-19 Sep. 1992
(Contract W-7405-eng-48)
(DE93-005821; UCRL-JC-109735; CONF-9209295-1) Avail: CASI HC A03/MF A01

As a consequence of advancements in Inertial Confinement Fusion research, LLNL is developing plans for a new 1.5 to 2 mega-joule solid-state Nd:glass laser designed to achieve fusion ignition. The new design is possible in part due to advances in optical coatings suitable for high power laser systems. High damage threshold mirrors and polarizers are comprised of electron beam deposited dielectric multilayers. Subthreshold illumination, or laser conditioning, of the multilayer coatings results in an increase in the damage thresholds by factors of 2 to 3 at 1.06 microns,

thus meeting the fluence requirements of the advanced architecture. For anti-reflective coatings, protective organic coatings for non-linear crystals, and phase plates for beam smoothing, sol-gel films provide high damage thresholds coatings at low cost. DOE

N93-22346# California Univ., Berkeley. Lawrence Berkeley Lab.
AN INFRARED FREE ELECTRON LASER SYSTEM FOR THE PROPOSED CHEMICAL DYNAMICS RESEARCH LABORATORY AT LBL BASED ON A 500 MHz SUPERCONDUCTING LINAC
K. J. Kim, R. Byrns, S. Chattopadhyay, R. Donahue, J. Edighoffer, R. Gough, E. Hoyer, W. Leemans, J. Staples, and B. Taylor et al Sep. 1992 11 p Presented at the 14th International Free Electron Laser Conference, Kobe, Japan, 23-28 Aug. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004723; LBL-32287; CONF-9208142-17) Avail: CASI HC A03/MF A01

A design of the Infrared Free Electron Laser (IRFEL) for the proposed Chemical Dynamics Research Laboratory (CDRL) at LBL is described. The design and choice of parameters are dictated by the unique requirements of the CDRL scientific program. The accelerator system is based on the 500 MHz superconducting cavity technology to achieve a wavelength stability of 10(exp -4). DOE

N93-22430# Los Alamos National Lab., NM.
OFTEN OVERLOOKED ELECTRICAL HAZARDS COMMON IN MANY LASERS
D. K. Thomas 1992 6 p Presented at the International Laser Safety Conference on Non-Beam Hazards, Cincinnati, OH, 1-4 Dec. 1992
(Contract W-7405-eng-36)
(DE93-003856; LA-UR-92-3837; CONF-921233-1) Avail: CASI HC A02/MF A01

One of the more dangerous non-beam hazards associated with laser work is electricity, often found in lethal doses within laser housings. However, some of the paths by which laser personnel may be exposed to this hazard are often overlooked by laser safety officers (LSO's), laser workers and laser manufacturers. One of the often overlooked paths by which laser personnel may come into contact with hazardous electrical current is due to a safety design deficiency prevalent in many laser products. This is that many lasers have performance adjustments within the protective housing that may obligate or entice personnel to perform potentially hazardous manipulative operations with the housing open; often with the safety interlocks defeated and the device fully energized. LSO's, laser workers, and laser manufacturers need to be aware of this hazard and should carefully analyze their lasers to determine if this exists within the lasers they use or manufacture. In most cases simple measures can be taken to prevent a potentially shocking laser experience. DOE

N93-22490# California Univ., Berkeley. Lawrence Berkeley Lab.
SELF-AMPLIFIED SPONTANEOUS EMISSION FOR SHORT WAVELENGTH COHERENT RADIATION
K. J. Kim and M. Xie Sep. 1992 16 p Presented at the 14th International Free Electron Laser Conference, Kobe, Japan, 23-28 Aug. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004724; LBL-32288; ESG-187; CONF-9208142-18) Avail: CASI HC A03/MF A01

We review the recent progress in our understanding of the self-amplified spontaneous emission (SASE), emphasizing the application to short wavelength generation. Simple formulae are given for the start-up, exponential gain and the saturation of SASE. Accelerator technologies producing high brightness electron beams required for short wavelength SASE are discussed. An example utilizing electron beams from a photocathode-linac system to produce 4nm SASE in the multigigawatt range is presented. DOE

N93-22529# Lawrence Livermore National Lab., CA.
SELF-FOCUSING OF BROADBAND LASER PULSES IN DISPERSIVE MEDIA
M. D. Feit and J. A. Fleck, Jr. Dec. 1992 17 p
(Contract W-7405-eng-48)
(DE93-007369; UCRL-ID-112523) Avail: CASI HC A03/MF A01

We have modeled the propagation in a nonlinear dispersive medium of high power laser beams having spectral bandwidth with randomly phased components. Such pulses exhibit temporal noise which generally increases the effect of self focusing compared to single frequency pulses with the same average intensity. However, it is found that dispersive effects are greatly enhanced by the spectral broadening from self-phase-modulation. The combination of self-phase-modulation and dispersion can actually raise the threshold for self-focusing with increasing pulse bandwidth, although not to the level found for a single frequency beam. DOE

N93-22539# Los Alamos National Lab., NM.
DESIGN AND MANUFACTURE OF OPTICAL SYSTEM FOR USE IN UV LITHOGRAPHY WITH THE FREE ELECTRON LASER
D. A. Byrd, V. K. Viswanathan, G. L. Woodfin, B. W. Horn, V. J. Lazazzera, and R. A. Schmell 1992 24 p Presented at the 17th Annual Society of Photo-Optical Instrumentation Engineers (SPIE) International Conference on Infrared and Millimeter Wave Sources, Pasadena, CA, 14-18 Dec. 1992
(Contract W-7405-eng-36)
(DE93-005440; LA-UR-92-4132; CONF-921217-3) Avail: CASI HC A03/MF A01

The imaging of sub-micron features using the Free Electron Laser (FEL) operating at 248nm is a current project at Los Alamos National Laboratories. The optical transfer systems which were designed to relay the ultra-violet (UV) optical output of the FEL resulting in expected imaged feature sizes in the 0.3-0.5 microns range are described. Nearly all optical subsystems are reflective, allowing the use of any optical wavelength, once the coatings were optimized. All refractive optics were UV Grade FuSi. The optical design, engineering, and the actual manufacture of the various component systems are described along with some experimental results. DOE

N93-22546# Sandia National Labs., Albuquerque, NM.
LASER SAFETY TRAINING PROGRAMS FOR A LARGE AND DIVERSE RESEARCH AND DEVELOPMENT LABORATORY
W. E. Stocum 1992 7 p Presented at the International Laser Safety Conference on Non-Beam Hazards, Cincinnati, OH, 1-4 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-006291; SAND-92-2422C; CONF-921233-2) Avail: CASI HC A02/MF A01

Sandia National Laboratories is a large multiprogram Research and Development laboratory which is operated by a contractor for the US Department of Energy. In the Laboratories, lasers are both the subject of research and the tools that are used in other research, development, and testing activities. Since 1979, laser safety training has been the primary focus of the Laboratories' laser safety program. Approximately 1100 personnel have been trained in formal courses during that time period. The formal course, presented on site by a contractor, consists of two full days of instruction. The course contents include the following topics: Laser technology and safety overview; Federal and ANSI laser standards summaries; Biological effects of laser radiation; Classification of lasers; Laser hazard analysis; Review of ANSI Z136.1 control measures; Laser eye protection. Recent emphasis on regulatory requirements, conduct of operations, and quality management has revealed a need to change the laser safety training curriculum. A new course for users of low power lasers (Class 2 and 3a) is being developed. A refresher course, a management awareness (self-study) course, and major changes in the current course are planned. DOE

N93-22691# Lawrence Livermore National Lab., CA.
HIGH POWER DIODE PUMPED SOLID STATE LASERS
R. Solarz, G. Albrecht, R. Beach, and B. Comaskey 25 Nov. 1992 10 p Presented at the International Conference of Lasers and Opto-Electronics, Beijing, China, 16-18 Oct. 1992
(Contract W-7405-eng-48)
(DE93-005818; UCRL-JC-108889; CONF-9210281-1) Avail: CASI HC A02/MF A01

Although operational for over twenty years, diode pumped solid state lasers have, for most of their existence, been limited to individual diodes pumping a tiny volume of active medium in an end pumped configuration. More recent years have witnessed the appearance of diode bars, packing around 100 diodes in a 1 cm bar which have enabled end and side pumped small solid state lasers at the few Watt level of output. This paper describes the subsequent development of how proper cooling and stacking of bars enables the fabrication of multi kill average power diode

pump arrays with irradiances of 1 kw/cm peak and 250 W/cm(exp 2) average pump power. Since typical conversion efficiencies from the diode light to the pumped laser output light are of order 30 percent or more, kW average power diode pumped solid state lasers now are possible. DOE

N93-22773# Los Alamos National Lab., NM.
APPLICATION OF 10 GeV ELECTRON DRIVEN X RAY LASER IN GAMMA RAY LASER RESEARCH
J. C. Solem 1992 8 p Presented at the Scientific Uses of X Ray Laser, Sanford, CA, 21 Oct. 1992
(Contract W-7405-eng-36)
(DE93-003775; LA-UR-92-3695; CONF-9210240-1) Avail: CASI HC A02/MF A01

The proposed short wavelength coherent light source driven by the SLAC 3 km linac might be used to induce transitions between nuclear isomeric states. If an isotope were found with energetically adjacent isomeric states, one short-lived and one long-lived, and it were possible to separate and concentrate the long-lived species, and other nuclear and solid-state parameters were favorable, it might be possible to convert sufficient population to the short-lived state to realize gamma-ray lasing. Even if the x-ray intensity were insufficient, study of such driven transitions would be quite valuable. DOE

N93-22920# California Univ., Berkeley. Lawrence Berkeley Lab.
CALCULATION OF 3-D FREE ELECTRON LASER GAIN: COMPARISON WITH SIMULATION AND GENERALIZATION TO ELLIPTICAL CROSS SECTION
Yong Ho Chin, Kwang-Je Kim, and Ming Xie Aug. 1992 10 p Presented at the 14th International Free Electron Laser Conference, Kobe, Japan, 23-28 Aug. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004768; LBL-32286; ESG-186; CONF-9208142-16) Avail: CASI HC A02/MF A01

In previous work, we have derived a dispersion relation for the free electron laser (FEL) gain in the exponential regime by taking into account the diffraction and electron's betatron oscillation. Here, we compare the growth rates obtained by solving the dispersion relation with those obtained by simulation calculation for the waterbag and the Gaussian models for the electron's transverse phase space distribution. The agreement is found to be good except for the limiting case where the Rayleigh length is much longer than the gain length (1-D limit). We also generalize the analysis to the case where the electron beam cross section is elliptical, as is usually the case in storage rings, and derive the first-order dispersion relation. DOE

N93-22921# California Univ., Berkeley. Lawrence Berkeley Lab.
FIELD PROFILE AND LOADING MEASUREMENTS ON HIGHER ORDER MODES IN A TWO CELL 500 MHz SUPERCONDUCTING STRUCTURE
W. Barry, J. Edighoffer, S. Chattopadhyay, and S. Fornaca (TRW Space Technology Labs., Redondo Beach, CA.) Aug. 1992 3 p Presented at the 16th International LINAC Conference, Ottawa, Ontario, 23-28 Aug. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004771; LBL-32178; ESG-176; CONF-9208109-70) Avail: CASI HC A01/MF A01

The Infrared Free Electron Laser, being designed at LBL as part of the Chemical Dynamics Research Laboratory, is based on a 500 MHz superconducting linac driver that consists of five 4-cell structures of the CERN/DESY type. A 500 MHz, 2-cell version of this structure is being used in a joint Stanford/LBL/BNL program to study accelerator issues relevant to the FEL applications. As part of this study, field profile and loading measurements of higher order modes have been made on the prototype structure. DOE

N93-22953# Lawrence Livermore National Lab., CA.
APPLICATIONS OF X RAY LASERS
R. London, ed. and D. Matthews, ed. 1992 205 p Presented at the Applications of X Ray Lasers Workshop, San Francisco, CA, 12-14 Jan. 1992
(Contract W-7405-eng-48)
(DE93-005299; CONF-9201103) Avail: CASI HC A10/MF A03

This report discusses the following topics: Status of x-ray laser research; status of x-ray laser applications; future x-ray laser development; x-ray laser research at Lawrence Livermore National Laboratory; x-ray laser applications workshop: summary of applications biology; x-ray imaging prospects in cell and molecular biology; x-ray lasers: applications to microscopy; some possible applications of x-ray lasers to the study of atomic structure and dynamics; applications of intense tunable x-ray sources in molecular physics: molecular photoionization dynamics; atomic and molecular physics applications; applications of x-ray lasers in basic research for microelectronics; review of potential x-ray laser applications in materials science and chemistry; soft x-ray lithography: a consideration of source requirements; holographic nano-lithography on semiconductors with x-ray lasers; and applications of x-ray lasers. DOE

N93-23290# Los Alamos National Lab., NM.
NEW ANALYSIS OF KrF PICOSECOND PULSE EXPERIMENT
D. E. Hanson and C. W. Patterson 23 Oct. 1992 8 p Presented at the 3rd Workshop on KrF Laser Technology, Abingdon, England, 3-6 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003805; LA-UR-92-3597; CONF-9211141-1) Avail: CASI HC A02/MF A01

A new model for analyzing the behavior of the KrF laser medium in response to a short (approximately 1 ps) saturating pulse is presented. For pulse durations much less than the mean collision time, the orientation of the KrF angular momentum vector, J, is fixed in space and the rotational M levels are inherently unmixed. The usual assumption of a single stimulated emission cross section, is replaced by one which includes a distribution of cross sections (and populations) which arise from the projection of the dipole along the laser polarization axis. We find that a simple, Franz-Nodvik analysis, using a single saturation fluence parameter, is inaccurate in the short pulse regime. DOE

N93-23307# Argonne National Lab., IL.
CO2 LASER BEAM PROPAGATION WITH ZnSe OPTICS
K. H. Leong, Yi Liu, and D. J. Holdridge 1992 11 p Presented at the International Congress on Application of Laser and Electro-Optics, Orlando, FL, 25-29 Oct. 1992
(Contract W-31-109-eng-38)
(DE93-002927; ANL/EP/CP-76191; CONF-9210217-2) Avail: CASI HC A03/MF A01

Beam propagation characteristics of ZnSe optics used in kiloWatt power CO2 laser aided material processing applications are determined using the Prometec Laser Beam Analyzer. The laser used was a Rofin Sinar RS6000 CO2 laser with mode aperturing. Beam power varied from 500W to 6300W and beam modes used were TEM(sub 00), TEM(sub 01), TEM(sub 10), and TEM(sub 20). Both transmissive and reflective optics were examined. The ZnSe lenses tested included meniscus, diffractive, and cylindrical lenses of 5 in. focal length and a 10 in. focal length integrating lens. Reflective optics included an integrator and a 5 in. focal length parabolic mirror for welding. Parameters obtained included beam propagation profiles, intensity profiles, depth of focus, spot size, and back focal length. A subset of the data obtained is presented here. Details of the work will appear in a full length paper. DOE

N93-23315# Lyon-1 Univ., Villeurbanne (France).
VISIBLE CHEMICAL LASERS: REACTIONS OF METASTABLE OXYGEN AND THE STUDY OF THE RED YOSHIDA REACTION Final Report
Roger Bacis 31 May 1992 57 p
(Grant AF-AFOSR-0235-91)
(AD-A260181) Avail: CASI HC A04/MF A01

During the period covered by the U.S. Air Force Grant we have identified the CuCl2 molecule as responsible for the I.R. and strong red emission in the 'Yoshida reaction.' The deep potential well of the CuCl2 ground state favors population inversion in the two involved excited states ((sup 2)delta(sub g) and (sup 2)Pi(sub u)). The lifetime of the highest excited electronic state (sup 2)Pi(sub u) makes laser action unlikely at 700 nm. But the metastable (sup 2)delta(sub g) state could reasonably be expected to sustain a population inversion. GRA

N93-23330# Lawrence Livermore National Lab., CA.
LASER DRIVEN HYDRODYNAMIC INSTABILITY EXPERIMENTS
B. A. Remington, S. V. Weber, S. W. Haan, J. D. Kilkenny, S. G. Glendinning,

R. J. Wallace, W. H. Goldstein, B. G. Wilson, and J. K. Nash Dec. 1992 25 p Presented at the Meeting of the Division of Plasma Physics of the American Physical Society, Seattle, WA, 16-20 Nov. 1992
(Contract W-7405-eng-48)
(DE93-005822; UCRL-JC-111286; CONF-921103-6) Avail: CASI HC A03/MF A01

We have conducted an extensive series of experiments on the Nova laser to measure hydrodynamic instabilities in planar foils accelerated by x-ray ablation. Single mode experiments allow a measurement of the fundamental growth rates from the linear well into the nonlinear regime; multimode foils allow an assessment of the degree of mode coupling; and surface-finish experiments allow a measurement of the evolution of a broad spectrum of random initial modes. Experimental results and comparisons with theory and simulations are presented. DOE

N93-23597 Rice Univ., Houston, TX.
STUDIES OF TUNABLE, HIGH POWER EXCIMER LASERS Ph.D. Thesis
Thomas Hofmann 1992 137 p
Avail: Univ. Microfilms Order No. DA9234397

A detailed investigation of tunable, high power excimer lasers, particularly of the electron-beam pumped XeF(C to A) laser, is presented. A numerical model is described which simulates the performance of such lasers. The output energy and temporal profile of an injection controlled XeF(C to A) excimer laser were successfully predicted for a wide range of experimental conditions. The XeF(C to A) excimer laser was demonstrated as a wideband tunable source of radiation capable of accessing a wavelength range from 455 to 530 nm. A high energy output of 1.2 J per pulse at a repetition rate of 1 Hz was accomplished by the use of a transverse gas flow cell. Injection controlled operation provided a narrow laser linewidth of 0.001 nm and three times diffraction limited spatial beam quality. Stimulated Raman scattering of the XeF(C to A) laser in hydrogen and liquid nitrogen was used to generate continuously tunable radiation between 525 and 650 nm with pulse energies exceeding 100 mJ. An energy conversion efficiency of 38 percent and a peak power of 35 MW were achieved. The XeF(C to A) excimer transition was characterized as a new gain medium for ultrashort pulse amplification. A gain bandwidth of 60 nm, as measured with 100 ps pulses, and a saturation energy density of 50 mJ/sq cm for 250 fs pulses constitute a 20-fold improvement over other short pulse excimer laser systems. An ultrahigh power, short pulse amplifier system was designed and built, based on the gain measurements. An unstable resonator, particularly adapted to low gain conditions and high temporal purity was developed for the XeF(C to A) excimer amplifier. A maximum output energy of 275 mJ was obtained for amplified 250 fs pulses, resulting in terawatt peak power. A spatial beam quality of 2.4 times the diffraction limit was measured, which makes it possible to achieve an intensity of larger than 1 10(exp 19) W/sq cm in a focused beam. Therefore, the XeF(C to A) excimer laser amplifier can be used in an exciting new field of studies involving the interaction of ultrahigh intensity light with matter.
Dissert. Abstr.

N93-23693# Sandia National Labs., Albuquerque, NM.
FALCON REMOTE LASER ALIGNMENT SYSTEM
T. W. Hamilton and G. A. Hebner 1993 19 p
(Contract DE-AC04-76DP-00789)
(DE93-006448; SAND-92-2393) Avail: CASI HC A03/MF A01

The FALCON Remote Laser Alignment System is used in a high radiation environment to adjust an optical assembly. The purpose of this report is to provide a description of the hardware used and to present the system configuration. Use of the system has increased the reliability and reproducibility of data as well as significantly reducing personnel radiation exposure. Based upon measured radiation dose, radiation exposure was reduced by at least a factor of two after implementing the remote alignment system. DOE

N93-24003# Rome Lab., Griffiss AFB, NY.
P+ CONTACTS ON GaAs FOR SEMICONDUCTOR LASERS Report, Jun. 1990 - Feb. 1992
Michael A. Parker, David A. Honey, Alexander Olewicz, Stuart I. Libby, and Paul D. Swanson Oct. 1992 21 p
(AD-A260207; RL-TR-92-242) Avail: CASI HC A03/MF A01

The physics and engineering of semiconductor electrical contacts and the importance of low resistance ohmic contacts for the best performance from electronic devices is discussed. A simple method is used to deduce the resistance of the electrical contacts and the bulk semiconductor. The fabrication process for P+ GaAs contacts is discussed. Test results are presented for the resistance of the metal electrodes, P+ GaAs bulk, the intrinsic contact resistance, and the temperature dependence of the metal and P+ GaAs. The distributed impedance of the contact structure for semiconductor lasers is discussed. GRA

N93-24071# Georgia Tech Research Inst., Atlanta.
SELECTIVE REACTIVITY, ULTRAFAST ENERGY TRANSFER AND THE DEVELOPMENT OF CHEMICALLY PUMPED VISIBLE LASERS Final Report, 1 Aug. 1989 - 30 Sep. 1992
James L. Gole 16 Nov. 1992 53 p
(Contract DAAL03-89-K-0140)
(AD-A260123; G41-618) Avail: CASI HC A04/MF A01

Two successful approaches to the formation of electronically inverted atomic diatomic configurations based on (1) highly efficient near resonant intermolecular energy transfer, and (2) highly efficient and selective fast direct chemical reaction are outlined. Near resonant energy transfer pumping from selectively formed metastable states of SiO and GeO is used to form thallium, gallium, sodium, and potassium atom laser amplifiers at lambda = 535, 417, 569, 616, 819, and 581 nm. The gain condition in the Tl, Ga, Na, and K systems forms the basis for full cavity oscillation on the Tl 7(sup 2)S(sub 1/2)- 6(sup 2)P(sub 3/2) transition at 535 nm and the Na 4d(sup 2)D - 3p(sup 2)P transition at 569 m. The extremely high cross section Na(sub n) (n=2,3) - X(Cl,Br,I) reactions are employed to create a continuous electronic population inversion based on the chemical pumping of sodium dimer (Na2). Optical gain through stimulated emission was demonstrated in select regions close to 527, 492, and 460 nm. The considered amplifiers are being optimized and modeled with a focus to increasing amplifier gain length and amplifying medium concentration so as to facilitate their conversion to visible chemical laser oscillators. The study of addition analog systems suggests that the two concepts considered wil be generic. GRA

N93-24137# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
EXPERIMENTAL AND THEORETICAL STUDY OF THE IODINE-SINGLET OXYGEN REACTION FOR USE IN A HIGH POWER CHEMICAL LASER (COIL) Ph.D. Thesis - Paris-Sud Univ., 1991 [ETUDE EXPERIMENTALE ET THEORIQUE DE LA REACTION IODE-OXYGENE SINGULET EN VUE DE LA REALISATION D'UN LASER CHIMIQUE DE PUISSANCE]
Bruno Barnault 1992 218 p In FRENCH
(ONERA-P-1992-3; ETN-93-93522) Avail: CASI HC A10/MF A03

The Chemical Oxygen Iodine Laser (COIL) works with the I(2 P 1/2) to I(2 P 3/2) transition of the atomic iodine. Its wavelength is 1.315 micrometers. The chemically produced metastable oxygen O2(1 Delta g) provides the energy needed to dissociate the molecular iodine and achieve the population inversion. The oxygen-iodine medium and a one kilowatt COIL project are presented. The various multicollisional processes proposed to explain the iodine dissociation are described. All of them involve the high vibrational levels I2 (X, V less than or equal to 43) as intermediate species. Absolute density measurements were made of these levels, by exictation spectroscopy. The measured values are in good agreement with the reaction constants and with the proposed processes. ESA

N93-24191 Stanford Univ., CA.
HIGH-RESOLUTION FREE-ELECTRON LASER SPECTROSCOPY Ph.D. Thesis
Eric Brent Szarmes 1992 155 p
Avail: Univ. Microfilms Order No. DA9234170

The broad and continuous turnability of the rf linac-driven free-electron laser (FEL), coupled with its high power picosecond time structure, has greatly enhanced the research capabilities in the field of infrared spectroscopy. However, the duration of the optical pulses is often too long to probe ultrafast processes that occur on time scales of a few tens to a few hundreds of femtoseconds, and the spectral structure of the optical beam, with closely spaced longitudinal modes in a bandwidth determined by the Fourier transform of the short pulses, poses a significant limitation of experiments requiring high spectral resolution. The temporal resolution can be improved by operating the FEL with electron pulses whose energy varies linearly with time; the resulting optical pulses possess substantial

frequency chirps and are susceptible to pulse compression in an external dispersive delay line. The spectral resolution can be enhanced by using an intracavity Michelson interferometer to couple successive optical pulses so that they build up from noise with a definite phase relationship; the longitudinal modes in the output beam are then separated by the rf frequency of the linac and can be individually filtered for applications in high resolution spectroscopy. In this dissertation, I develop small signal analyses for each of these modes of operation, and report the results of numerical pulse propagation simulations whose parameters were chosen to guide the design of feasible experiments on the Mark III FEL. Chirped-pulse simulations using modest energy chirps have demonstrated a x15 compression ratio at saturated power levels for 3.4 ps optical pulses at 3.35 microns, and coupled pulse simulations have indicated substantial longitudinal mode reduction on microsecond time scales. I also develop a simplified derivation of the FEL coupled mode equations using conventional mode locked laser theory, and solve them numerically in the frequency domain to describe the detuning properties of the Michelson resonator FEL. Finally, I report the first operation of a Michelson mirror resonator on the Mark III FEL, and present indirect evidence for phase locked operation using a beamsplitter reflectance of only 1.4 percent. Dissert. Abstr.

N93-24276# Multilayer Optics and X-ray Technology, Inc., Provo, UT.
INEXPENSIVE CAPILLARY DISCHARGE X RAY LASER DRIVER
A. M. Panin 29 Jan. 1993 23 p
(Contract N00014-92-C-2218)
(AD-A260388) Avail: CASI HC A03/MF A01

In this report, we present the results of our search for lasing schemes using a collisional pumping mechanism of active level population suitable for a capillary discharge plasma. We have performed atomic data calculations which give us accurate figures for energy level positions for Ne-like Ar, including highly excited levels which have not been studied experimentally and which are of significant interest for short-wavelength lasing. We also calculated radiative transitions probabilities as well as branch coefficients for transitions of interest for lasing. The calculations were performed not only for Ne-like ions but also for Ni-like ions of krypton and molybdenum, as the Ni-like scheme seems to be promising for scaling to lower wavelengths. Using the results of these calculations, we are able to predict possible laser lines and to estimate their relative intensities. GRA

N93-24320# Naval Postgraduate School, Monterey, CA.
PROTOTYPING OF TWO-BEAM LASER INTERFEROMETER FOR MEASUREMENT OF OPTICAL TURBULENCE ALONG EXTENDED PATHS M.S. Thesis
Carl S. Barbour Dec. 1992 46 p
(AD-A260229) Avail: CASI HC A03/MF A01

This thesis demonstrates a proof-of-concept experimental validation of a prototype two-beam, division of wavefront laser interferometer that provides real-time measurement of the optical path difference, and subsequent phase distortion, caused by atmospheric turbulence along an extended horizontal path. Prototype's signal processing incorporates use of specialized phase comparator circuit developed by author's advisor, D.S. Davis. Photographs and results cited of the prototype' receiver's output offer proof of the validity of the basic design. Further research of this technology is expected to support future laser/adaptive optics long range weapon applications. GRA

N93-24323# Phillips Lab., Kirtland AFB, NM.
SEMICONDUCTOR LASER WITH A SELF-PUMPED PHASE CONJUGATE EXTERNAL CAVITY Final Report, 1 Oct. 1990 - 31 Jul. 1992
Bruce William Liby Oct. 1992 170 p
(AD-A260028; AD-E201288; PL-TR-92-1049) Avail: CASI HC A08/MF A02

This dissertation is intended to study the effects of self-pumped phase-conjugate feedback on a semiconductor laser. The concept of the unidirectional ring passive phase-conjugate mirror (PPCM) external cavity semiconductor laser (URECL) is introduced. This device consists of a laser diode coupled to a self-pumped ring phase-conjugate mirror. The URECL is compared and contrasted with a conventional external cavity semiconductor laser (CECL) that models a simple dielectric reflector for the feedback device, and with a phase-conjugate external cavity laser (PCECL) that models theoretically ideal phase conjugation as the feedback mechanism. The effective reflectivities for the different types of reflectors are derived and compared. The rate equations for all three cases are derived and plotted for comparison. The boundary conditions for the phase-conjugate cases are derived and experimental evidence is used to support the claim that a 2npi (n being a variable integer) phase shift occurs for the PCECL and URECL. The multimode behavior of the free running laser, the CECL, and the URECL are compared. Experimental evidence of coherence collapse is presented and discussed. The dynamic rate equations are given and contrasted. The beam quality of the unidirectional ring PPCM is considered. GRA

N93-24326# Brookhaven National Lab., Upton, NY.
LASER SPECTROSCOPY OF CHEMICALLY REACTIVE SPECIES
Ming Wu and T. J. Sears 1993 10 p Presented at the International Society for Optical Engineering (SPIE) Conference, Los Angeles, CA, 16-23 Jan. 1993
(Contract DE-AC02-76CH-00016)
(DE93-006672; BNL-48452; CONF-930159-5) Avail: CASI HC A02/MF A01

We report the observation of stimulated emission pumping spectra in the NCO radical formed in a supersonic free jet expansion by the reaction between photolytically generated CN radicals and O2. The spectra give rotationally resolved information on high lying vibrational levels that are difficult or impossible to detect by conventional single photon spectroscopic techniques. These new data provide detailed insight into the Renner-Teller, spin-orbit and Fermi-resonance coupling in the molecule. They also provide a solid basis for future state-selected chemical and dynamical studies involving this important radical species. DOE

N93-22160*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MULTI-BEAM RANGE IMAGER FOR AUTONOMOUS OPERATIONS
Neville I. Marzwell, H. Sang Lee (Science and Engineering Services, Inc., Burtonsville, MD.), and R. Ramaswami (Science and Engineering Services, Inc., Burtonsville, MD.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 111-118 (For primary document see N93-22149 08-99)
(Contract NAS7-1186)
Avail: CASI HC A02/MF A04

N93-22180*# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.
EXCIMER LASER PROCESSING OF BACKSIDE-ILLUMINATED CCDS
S. D. Russell *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 296-303 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22197*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THREE-DIMENSIONAL LASER WINDOW FORMATION FOR INDUSTRIAL APPLICATION
Vincent G. Verhoff and David Kowalski *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 454-459 (For primary document see N93-22149 08-99)
Avail: CASI HC A04/MF A04

N93-22198*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH PERFORMANCE SAPPHIRE WINDOWS
Stephen C. Bates (Advanced Fuel Research, Inc., East Hartford, CT.) and Larry Liou *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 460-469 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22247*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LASER DOCKING SENSOR ENGINEERING MODEL Abstract Only
Kent Dekome and Joseph M. Barr (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous

and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22250*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
COHERENT DOPPLER LIDAR FOR AUTOMATED SPACE VEHICLE, RENDEZVOUS, STATION-KEEPING AND CAPTURE Abstract Only
James A. Dunkin *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22258*# Autonomous Technologies, Orlando, FL.
LADAR VISION TECHNOLOGY FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only
Randy W. Frey *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22278*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A COMPARISON OF LASER BASED RANGING SYSTEMS FOR AR/C CATEGORY 1: HARDWARE Abstract Only
Stephen J. Katzberg and Pleasant W. Goode, IV *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22297*# Rockwell International Corp., Seal Beach, CA.
APPROACH RANGE AND VELOCITY DETERMINATION USING LASER SENSORS AND RETROREFLECTOR TARGETS Abstract Only
L. Race, K. J. Kim, J. Wang, W. Schoknecht, and William J. Donovan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-23260# Stuttgart Univ. (Germany).
LASER DIAGNOSTICS
G. Dodel, E. Holzhauer, G. Rohrbach, A. Allmendinger, and K. Kopp *In its* Activities Report of the Institute of Plasma Research 1992 p 12-15 (For primary document see N93-23258 08-75)
Avail: CASI HC A01/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N93-22384* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
BLIND FASTENING APPARATUS Patent
Norman F. Willey, inventor (to NASA) and James F. Linker, inventor (to NASA) 30 Mar. 1993 9 p Filed 8 Aug. 1991 Supersedes N92-11354 (30 - 2, p 243)
(NASA-Case-LAR-14542-1; US-Patent-5,197,839;
US-Patent-Appl-SN-743485; US-Patent-Class-411-340;
US-Patent-Class-411-103; US-Patent-Class-411-402;
Int-Patent-Class-F16B-21/00) Avail: US Patent and Trademark Office

An anchor nut insert is provided having external threads for engaging an internally threaded receptacle of a fixture to be installed. The fixture also has two side wings flanking the receptacle and having fastener holes. An insert driver is provided having a projecting blade which engages a slot in the anchor nut insert for driving the insert. A guide member, such as a wire, passes through symmetry axes of the anchor nut insert and insert driver such that the anchor nut insert is located between the insert driver and a first terminal end of the guide wire. A swag is provided on this terminal end to prevent the anchor nut insert and insert driver from sliding off the end. The fixture with the installed anchor nut insert is fed through the central hole in a structure wall having a blind side. The fixture is rotated until the wing holes are aligned with side holes in the wall and then the fixture is pulled flush against the blind side via the guide wire. Fasteners are then inserted through the hole and the anchor nut insert removed via the driver, exposing the fixed threaded receptacle for engagement as desired.
Official Gazette of the U.S. Patent and Trademark Office

N93-22413# Morgantown Technology Center, WV.
OVERVIEW OF ADVANCED TURBINE SYSTEMS PROGRAM
H. A. Webb and R. A. Bajura 1992 12 p Presented at the US Department of Energy Contractors Review Meeting on Coal-Fueled Heat Engines, Advanced PFBC and Gas Stream Cleanup Systems, Morgantown, WV, 27-28 Oct. 1992
(DE93-003193; DOE/METC-C/93/7042; CONF-921034-2) Avail: CASI HC A03/MF A01

The US Department of Energy initiated a program to develop advanced gas turbine systems to serve both central power and industrial power generation markets. The Advanced Turbine Systems (ATS) Program will lead to commercial offerings by the private sector by 2002. ATS will be developed to fire natural gas but will be adaptable to coal and biomass firing. The systems will be: highly efficient (15 percent improvement over today's best systems); environmentally superior (10 percent reduction in nitrogen oxides over today's best systems); and cost competitive (10 percent reduction in cost of electricity). The ATS Program has five elements. Innovative cycle development will lead to the demonstration of systems with advanced gas turbine cycles using current gas turbine technology. High temperature development will lead to the increased firing temperatures needed to achieve ATS Program efficiency goals. Ceramic component development/demonstration will expand the current DOE/CE program to demonstrate industrial-scale turbines with ceramic components. Technology base will support the overall program by conducting research and development (R&D) on generic technology issues. Coal application studies will adapt technology developed in the ATS program to coal-fired systems being developed in other DOE programs. DOE

N93-22466*# McDonnell-Douglas Helicopter Co., Mesa, AZ.
ADVANCED ROTORCRAFT TRANSMISSION (ART) PROGRAM Final Report
Gregory F. Heath and Robert B. Bossler, Jr. (Lucas Western, Inc., City of Industry, CA.) Jan. 1993 222 p
(Contract NAS3-25454; DA Proj. 1L1-62211-A-47-A; RTOP 505-62-OK)
(NASA-CR-191057; ARL-CR-14; NAS 1.26:191057) Avail: CASI HC A10/MF A03

Work performed by the McDonnell Douglas Helicopter Company and Lucas Western, Inc. within the U.S. Army/NASA Advanced Rotorcraft Transmission (ART) Program is summarized. The design of a 5000 horsepower transmission for a next generation advanced attack helicopter is described. Government goals for the program were to define technology and detail design the ART to meet, as a minimum, a weight reduction of 25 percent, an internal noise reduction of 10 dB plus a mean-time-between-removal (MTBR) of 5000 hours compared to a state-of-the-art baseline transmission. The split-torque transmission developed using face gears achieved a 40 percent weight reduction, a 9.6 dB noise reduction and a 5270 hour MTBR in meeting or exceeding the above goals. Aircraft mission performance and cost improvements resulting from installation of the ART would include a 17 to 22 percent improvement in loss-exchange ratio during combat, a 22 percent improvement in mean-time-between-failure, a transmission acquisition cost savings of 23 percent of $165K, per unit, and an average transmission direct operating cost savings of 33 percent, or $24K per flight hour. Face gear tests performed successfully at NASA Lewis are summarized. Also, program results of advanced material tooth scoring tests, single tooth bending tests, Charpy impact energy tests, compact tension fracture toughness tests and tensile strength tests are summarized. Author (revised)

N93-22494# Allied-Signal Aerospace Co., Kansas City, MO.
GTAW PENETRATION BASED ON ELECTRODE TIP LOCATION VERSUS WELD JOINT CENTER LINE
G. J. Daumeyer, III Nov. 1992 37 p
(Contract DE-AC04-76DP-00613)
(DE93-004910; KCP-613-4868) Avail: CASI HC A03/MF A01

Gas Tungsten Arc Welding (GTAW) is often the chosen process for final enclosure welds of heat sensitive electrical and electronic product. GTAW is used to produce welds that satisfy design requirements (usually a penetration requirement) and not expose the product to such high heat that would cause unwanted damage. An important variable in the GTAW process is the location of the Electrode tip over the weld joint center line. This study shows the tolerance of positional location over a narrow scope. Using coupons which represent the W88 container weld joint geometry, penetration vs. electrode tip positional location (offset) is investigated. Results indicate a positional location tolerance of +/- 0.008 in. is acceptable. Several different major components (MC's) supporting various weapons programs require low heat input GTA welds. The electrode tip positional location tolerance is determined by each MC's weld joint tolerances and heat sensitivity. For this short study, the weld joint geometry of a container weld was used. These coupons were welded with the specified weld schedule and one additional weld schedule in order to show the relationship based on both travel speed and gap. Multiple coupon welds were made to eliminate error in the results. Within the scope of this research, a positional tolerance of +/- 0.008 in. of the electrode center over the weld joint center is required. For other MC's this tolerance may be tighter or more relaxed depending upon the specific considerations. DOE

N93-22737# Urban Consortium for Technology Initiatives. Energy Task Force.

ANALYSIS OF OPERATIONAL, INSTITUTIONAL AND INTERNATIONAL LIMITATIONS FOR ALTERNATIVE FUEL VEHICLES AND TECHNOLOGIES: MEANS/METHODS FOR IMPLEMENTING CHANGES

Jul. 1992 89 p Prepared in cooperation with Public Technology, Inc., Washington, DC, and City of Detroit, MI

(Contract DE-FG02-90CE-27504)

(DE93-005611; DOE/CE-27504/5) Avail: CASI HC A05/MF A01

This project focused upon the development of an approach to assist public fleet managers in evaluating the characteristics and availability of alternative fuels (AF's) and alternative fuel vehicles (AFV's) that will serve as possible replacements for vehicles currently serving the needs of various public entities. Also of concern were the institutional/international limitations for alternative fuels and alternative fuel vehicles. The City of Detroit and other public agencies in the Detroit area were the particular focus for the activities. As the development and initial stages of use of alternative fuels and alternative fuel vehicles proceeds, there will be an increasing need to provide information and guidance to decision-makers regarding differences in requirements and features of these fuels and vehicles. There will be differences in requirements for servicing, managing, and regulating. There will also be misunderstanding and misperception. There have been volumes of data collected on AFV'S, and as technology is improved, new data is constantly added. There are not, however, condensed and effective sources of information for public vehicle fleet managers on vehicle and equipment sources, characteristics, performance, costs, and environmental benefits. While theoretical modeling of public fleet requirements has been done, there do not seem to be readily available 'practical'. There is a need to provide the best possible information and means to minimize the problems for introducing the effective use of alternative fuels and alternative fuel vehicles. DOE

N93-22761# Oak Ridge National Lab., TN.

CONTROLLING CHAOS IN SPARK-IGNITION ENGINES

R. M. Wagner (Missouri Univ., Rolla.), C. S. Daw, and J. F. Thomas 1993 5 p Presented at the 1993 Joint Central States and Eastern Sections of the Combustion Institute, New Orleans, LA, 15-17 Mar. 1993

(Contract DE-AC05-84OR-21400)

(DE93-005754; CONF-930392-1) Avail: CASI HC A01/MF A01

A previously proposed finite-difference model for cyclical variations in spark-ignition engines has been modified and used to further explore the occurrence of deterministic chaos. A methodology for exploiting the underlying deterministic structure to control the chaos is proposed. It is demonstrated that this methodology can be used to greatly reduce or eliminate cyclical variations, even in the presence of substantial background noise. DOE

N93-22818# Westinghouse Savannah River Co., Aiken, SC.

PREDICTION OF THE QUALITY OF RESISTANCE WELDS BY COMPUTER BASED COLOR IMAGE ANALYSIS

M. J. Pechersky, K. A. Zeoli, and P. A. Kestin 1992 15 p Presented at the International Metallographic Society Annual Meeting, Denver, CO, 2-5 Aug. 1992

(Contract DE-AC09-89SR-18035)

(DE93-002402; WSRC-MS-92-051; CONF-9208178-1) Avail: CASI HC A03/MF A01

Experiments which were completed to correlate the quality of electric resistance pinch welds with an automated computer analysis of the weld surface are discussed. The pinch welds were performed on small diameter stainless steel tubes after they were annealed in air at several different temperatures to form an oxide layer on the weld surfaces. The images of the tube bore were collected with a borescope, stored in a computer and analyzed. The analysis consisted of computing a parameter which gave a representation of the color integrated over the inspected region. This color parameter was then used to rank the tubes in order of their relative oxidation level. Once this was performed the tubes were welded and low magnification metallography was performed on the welds. It was found that the color analysis gave a perfect correlation with the oxidation levels and that the weld quality was inversely proportional to the amount of oxidation. It was also shown that the color analysis was robust in the sense that the sorting was independent of the borescope illumination level over a large range for both oxidized and unoxidized stems. Thus, the color parameter chosen was an excellent predictor of the weld quality. DOE

N93-22826*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EVALUATION OF AN OIL-DEBRIS MONITORING DEVICE FOR USE IN HELICOPTER TRANSMISSIONS

David G. Lewicki, Donald M. Blanchette (National Defence Headquarters, Ottawa, Ontario.), and Gilles Biron (Quality Engineering Test Establishment, Hull, Quebec.) Aug. 1992 19 p

(DA Proj. 1L1-62211-A-47-A; RTOP 505-63-36)

(NASA-TM-105830; E-7265; NAS 1.15:105830; AVSCOM-TR-92-C-007)

Avail: CASI HC A03/MF A01

Experimental tests were performed on an OH-58A helicopter main-rotor transmission to evaluate an oil-debris monitoring device (ODMD). The tests were performed in the NASA 500-hp Helicopter Transmission Test Stand. Five endurance tests were run as part of a U.S. Navy/NASA/Army advanced lubricants program. The tests were run at 100 percent design speed, 117-percent design torque, and 121 C (250 F) oil inlet temperature. Each test lasted between 29 and 122 hr. The oils that were used conformed to MIL-L-23699 and DOD-L-85734 specifications. One test produced a massive sun-gear fatigue failure; another test produced a small spall on one sun-gear tooth; and a third test produced a catastrophic planet-bearing cage failure. The ODMD results were compared with oil spectroscopy results. The capability of the ODMD to detect transmission component failures was not demonstrated. Two of the five tests produced large amounts of debris. For these two tests, two separate ODMD sensors failed, possibly because of prolonged exposure to relatively high oil temperatures. One test produced a small amount of debris and was not detected by the ODMD or by oil spectroscopy. In general, the ODMD results matched the oil spectroscopy results. The ODMD results were extremely sensitive to oil temperature and flow rate. Author

N93-22891# Westinghouse Savannah River Co., Aiken, SC.

MODIFIED IMPEDANCE CONTROL FOR ROBOTIC SAW CUTTING: SIMULATION AND IMPLEMENTATION IN THREE DEGREES OF FREEDOM

E. M. Kriikku, D. L. Reynolds (Clemson Univ., SC.), J. J. Carroll (Clemson Univ., SC.), and D. M. Dawson (Clemson Univ., SC.) 1993 8 p Presented at the 5th Topical Meeting on Robotics and Remote Systems, Knoxville, TN, 26-29 Apr. 1993

(Contract DE-AC09-89SR-18035)

(DE93-002162; WSRC-MS-92-371; CONF-930403-1) Avail: CASI HC A02/MF A01

The Savannah River Site (SRS) production and decommissioning operations produce solid radioactive transuranic (TRU) waste. This waste must be repackaged and sent to the Waste Isolation Pilot Plant (WIPP) for permanent disposal. The Savannah River Technology Center (SRTC) built a test facility to demonstrate simulated waste processing. The test facility uses a CIMCORP multi-axis robot system, a CIMROC(trademark) II robot controller, and an electric circular saw to remotely open and size reduce

plywood crates. The robot can either be teleoperated using joysticks or autonomously controlled via the CIMROC(trademark) II. Both methods are inadequate for circular saw cutting of plywood crates due to frequent saw blade binding. Blade binding results from the current commercial robot controller limitations. The limitations are overcome by incorporating additional sensor information into the existing controller structure. In this paper we utilize a force sensor and a frequency counter to implement a modified impedance controller which prevents saw blade binding. DOE

N93-22892# Westinghouse Savannah River Co., Aiken, SC.
PIPE CRAWLER DEVELOPMENT FOR DUCT ELBOW REMOVAL
W. T. Zollinger and R. C. Treanor 1992 8 p Presented at the 5th Topical Meeting on Robotics and Remote Systems, Knoxville, TN, 26-29 Apr. 1993
(Contract DE-AC09-89SR-18035)
(DE93-002169; WSRC-MS-91-549; CONF-930403-2) Avail: CASI HC A02/MF A01

This paper describes the development of equipment for removing an elbow in a 36 inch diameter ventilation line by cutting from the inside. Radiation levels, high air flow and physical constraints preclude any manual rework of the ventilation system. A remotely operated pipe crawler was developed. Testing has been performed in a full-scale mockup which models the ventilation duct configuration with the exception of radiation levels. The results gathered from the testing are discussed, and illustrate the strengths and weaknesses of the crawler and plasma arc torch system. To date, the equipment has successfully completed the tasks of maneuvering through the duct geometry, performing the two required cuts, and backing out of the duct mockup. The elbow successfully fell away from the main duct, showing that the line would be clear of obstructions. DOE

N93-22901# Environmental Protection Agency, Ann Arbor, MI. Control Technology and Applications Branch.
EVALUATION OF RESISTIVELY HEATED FUEL INJECTION TECHNOLOGY TO REDUCE COLD START EMISSIONS AND ASSIST STARTING/DRIVEAWAY OF A METHANOL-FUELED VEHICLE
Gregory K. Piotrowski and Ronald M. Schaefer Mar. 1992 22 p
(PB93-144350; EPA/AA/CTAB-92/02) Avail: CASI HC A03/MF A01

The report provides the results from a program to evaluate a set of heated fuel injectors on an M100 fueled vehicle in an attempt to lower cold start emissions of unburned fuel and carbon monoxide and to improve cold start ability and drive ability. This technology was evaluated at several different temperatures. GRA

N93-22902# Environmental Protection Agency, Ann Arbor, MI. Technology Development Group.
CONVERSION OF METHANOL-FUELED 16-VALVE, 4-CYLINDER ENGINE TO OPERATION ON GASEOUS 2H2/CO FUEL Interim Report No. 4
Ronald M. Schaefer, Fakhart J. Hamady, and James C. Martin Sep. 1992 27 p
(PB93-144376; EPA/AA/TDG-92/06) Avail: CASI HC A03/MF A01

The report describes progress to date on a project to convert a Nissan CA18DE engine previously modified for operation on M100 neat methanol to operation on dissociated methanol (2H2/CO) gaseous fuel. This engine was operated on both M100 and simulated dissociated methanol (67 percent hydrocarbon and 33 percent carbon monoxide) fuels. This report describes recent modifications made to the engine and fuel delivery system and summarizes the results from recent testing. GRA

N93-22923# Los Alamos National Lab., NM.
OPTIMAL BOLT PRELOAD FOR DYNAMIC LOADING
T. A. Duffey 1992 17 p Presented at the Symposium on Structural Crashworthiness and Failure, Liverpool, England, 14-16 Apr. 1993
(Contract W-7405-eng-36)
(DE92-017527; LA-UR-92-1879; CONF-930418-1) Avail: CASI HC A03/MF A01

A simple spring-mass model is developed for closure bolting systems. The model takes into account the effects of bolt prestress. An analytical solution is developed for the case of an initially peaked, exponentially decaying internal pressure pulse acting on the closure. The dependence of peak bolt stresses and deflections on bolt prestress level is investigated and an optimal prestress that minimizes peak bolt stress is found in certain cases. Vulnerability curves are developed for bolted-closure systems to provide rapid evaluation of the dynamic capacity of designs for a range in bolt prestress. DOE

N93-22925# Oak Ridge National Lab., TN.
FRICTION MICROPROBE INVESTIGATION OF PARTICLE LAYER EFFECTS ON SLIDING FRICTION
P. J. Blau 1993 27 p Presented at the 9th International Conference of Wear of Materials, San Francisco, CA, 13-17 Apr. 1993
(Contract DE-AC05-84OR-21400)
(DE92-018868; CONF-930414-2) Avail: CASI HC A03/MF A01

Interfacial particles (third-bodies), resulting from wear or external contamination, can alter and even dominate the frictional behavior of solid-solid sliding in the absence of effective particle removal processes (e.g., lubricant flow). A unique friction microprobe, developed at Oak Ridge National Laboratory, was used to conduct fine-scale friction studies using 1.0 mm diameter stainless steel spheres sliding on several sizes of loose layers of fine aluminum oxide powders on both aluminum and alumina surfaces. Conventional pin-on-disk experiments were conducted to compare behavior with the friction microprobe results. The behavior of the relatively thick particle layers was found to be independent of the nature of underlying substrate, substantiating previous work by other investigators. The time-dependent behavior of friction, for a spherical macrocontact starting from rest, could generally be represented by a series of five rather distinct phases involving static compression, slider breakaway, transition to steady state, and dynamic layer instability. A friction model for the steady state condition, which incorporates lamellar powder layer behavior, is described. DOE

N93-23019*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LOW-NOISE, HIGH-STRENGTH, SPIRAL-BEVEL GEARS FOR HELICOPTER TRANSMISSIONS
David G. Lewicki, Robert F. Handschuh, Zachary S. Henry (Bell Helicopter Co., Fort Worth, TX.), and Faydor L. Litvin (Chicago Univ., IL.) Jun. 1993 15 p Proposed for presentation at the 29th Joint Propulsion Conference and Exhibit, Monterey, CA, 28-30 Jun. 1993; sponsored by AIAA, SAE, ASME, and ASEE
(DA Proj. 1L1-62211-A-47-A; RTOP 505-62-10)
(NASA-TM-106080; E-7698; NAS 1.15:106080; AIAA Paper 93-2149; ARL-MR-71) Avail: CASI HC A03/MF A01

Improvements in spiral-bevel gear design were investigated to support the Army/NASA Advanced Rotorcraft Transmission program. Program objectives were to reduce weight by 25 percent, reduce noise by 10 dB, and increase life to 5000 hr mean-time-between-removal. To help meet these goals, advanced-design spiral-bevel gears were tested in an OH-58D helicopter transmission using the NASA 500-hp Helicopter Transmission Test Stand. Three different gear designs tested included: (1) the current design of the OH-58D transmission except gear material X-53 instead of AISI 9310; (2) a higher-strength design the same as the current but with a full fillet radius to reduce gear tooth bending stress (and thus, weight); and (3) a lower-noise design the same as the high-strength but with modified tooth geometry to reduce transmission error and noise. Noise, vibration, and tooth strain tests were performed and significant gear stress and noise reductions were achieved. Author

N93-23020# Technische Univ., Berlin (Germany). Inst. of Aeronautics and Astronautics.
STABILITY AND STABILITY DEGREE OF A CRACKED FLEXIBLE ROTOR SUPPORTED ON JOURNAL BEARINGS
Meng Gueng (Northwestern Polytechnical Univ., Xian, China.) and Robert Gasch Jan. 1992 45 p Sponsored by Alexander von Humboldt Foundation, and DFG
(ILR-Mitt-268(1991); ETN-93-93460) Avail: CASI HC A03/MF A01

The stability and the stability degree of a flexible cracked rotor supported on different kinds of journal bearings were investigated. The influences of the crack stiffness ratio, the fixed Sommerfeld number, the gravity parameter, and the mass ratio were analyzed. It was found that the rotor crack has almost no influence on the system stability and stability degree outside the crack ridge zones; while within the crack ridge zones, the stability and stability degree depend both on the crack and system parameters. In some cases, the system may still be stable even when the crack is very

large. The influence of mass ratio on the stability degree is small and the influence of fixed Sommerfeld number on the crack stability degree is small although the Sommerfeld number has a large influence on the stability degree of uncracked rotor. ESA

N93-23075* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ENERGY DISSIPATOR Patent

Horacio M. DeLaFuente, inventor (to NASA), Kornel Nagy, inventor (to NASA), and Clarence J. Wesselski, inventor (to NASA) 30 Mar. 1993 7 p Filed 15 Feb. 1991 Supersedes N91-23492 (29 - 15, p 2435)
(NASA-Case-MSC-21555-1; US-Patent-5,197,573;
US-Patent-Appl-SN-656925; US-Patent-Class-188-67;
US-Patent-Class-188-82.84; US-Patent-Class-188-129;
Int-Patent-Class-F16D-63/00) Avail: US Patent and Trademark Office

An all metal energy dissipator construction is disclosed for dissipating kinetic energy force (F) by rolling balls which are forced by a tapered surface on an expandable sleeve to frictionally load a force rod. The balls are maintained in an initial position by a plate member which is biased by a spring member. A spring member returns the force rod to its initial position after a loading force is removed.
Official Gazette of the U.S. Patent and Trademark Office

N93-23076* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

QUICK ACTING GIMBAL JOINT Patent

William B. Wood, inventor (to NASA) and Gary D. Krch, inventor (to NASA) 30 Mar. 1993 9 p Filed 16 Jun. 1992 Supersedes N92-30316 (30 - 21, p 3658)
(NASA-Case-MSC-21918-1; US-Patent-5,197,817;
US-Patent-Appl-SN-899536; US-Patent-Class-403-93;
US-Patent-Class-403-97; US-Patent-Class-403-84; US-Patent-Class-403-324;
Int-Patent-Class-F16C-11/00) Avail: US Patent and Trademark Office

The present invention relates to an adjustable linkage assembly for selectively retaining the position of one member pivotable with respect to another member. More specifically, the invention relates to a linkage assembly commonly referred to as a gimbal joint, and particularly to a quick release or quick acting gimbal joint. The assembly is relatively simple in construction, compact in size, and has superior locking strength in any selected position. The device can be quickly and easily actuated, without separate tooling, by inexperienced personnel or by computer controlled equipment. It also is designed to prevent inadvertent actuation.
Official Gazette of the U.S. Patent and Trademark Office

N93-23078* National Aeronautics and Space Administration. Pasadena Office, CA.

FORCE REFLECTING HAND CONTROLLER Patent

Douglas A. McAffee, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), Edward R. Snow, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), and William T. Townsend, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 16 Mar. 1993 25 p Filed 31 Oct. 1990
(NASA-Case-NPO-17851-1-CU; US-Patent-5,193,963;
US-Patent-Appl-SN-608658; US-Patent-Class-414-5; US-Patent-Class-414-7;
Int-Patent-Class-B25J-3/00) Avail: US Patent and Trademark Office

A universal input device for interfacing a human operator with a slave machine such as a robot or the like includes a plurality of serially connected mechanical links extending from a base. A handgrip is connected to the mechanical links distal from the base such that a human operator may grasp the handgrip and control the position thereof relative to the base through the mechanical links. A plurality of rotary joints is arranged to connect the mechanical links together to provide at least three translational degrees of freedom and at least three rotational degrees of freedom of motion of the handgrip relative to the base. A cable and pulley assembly for each joint is connected to a corresponding motor for transmitting forces from the slave machine to the handgrip to provide kinesthetic feedback to the operator and for producing control signals that may be transmitted from the handgrip to the slave machine. The device gives excellent kinesthetic feedback, high-fidelity force/torque feedback, a kinematically simple structure, mechanically decoupled motion in all six degrees of freedom, and zero backlash. The device also has a much larger work envelope, greater stiffness and responsiveness, smaller stowage volume, and better overlap of the human operator's range of motion than previous designs. Official Gazette of the U.S. Patent and Trademark Office

N93-23188 Cleveland State Univ., OH.

PLANETARY GEAR TRAIN RING GEAR AND SUPPORT STRUCTURE INVESTIGATION Ph.D. Thesis

Mark J. Valco 1992 357 p
Avail: Univ. Microfilms Order No. DA9237171

Most helicopter transmissions utilize a planetary gear train as the final speed reduction stage. Due to weight constraints these transmissions have high power-to-weight ratios and relatively flexible structures. This investigation addresses the analysis of planetary gear trains with the ring gear mounted on a flexible support structure. The approach utilizes recent advances in automated contact methods for nonlinear finite element analysis. Rather than using a line of action spring to model gear pair mesh stiffness, finite element models of complete gears are developed, and the elastic gear members are engaged and rolled through mesh. The procedure includes detailed gear tooth geometry with profile modifications. A nonlinear approach is required due to large displacements associated with gear rotation and nonlinear boundary conditions associated with the gear tooth surface contact. The updated Lagrangian formulation and the MARC K-4.1 automated contact features are applied in the analysis. The ring gear support structure is modeled by an elastic foundation linking the ring gear to a rigid support. Calculation of gear pair deflections, stresses, transmission error, and mesh stiffness through the gear meshing cycle are demonstrated for external and internal spur gear pairs and a planetary gear train. Issues relating to the accuracy of the nonlinear finite element contact method, gear mesh stiffness, transmission error, and the planetary gear train elastic support structure are discussed. Dissert. Abstr.

N93-23275# Environmental Protection Agency, Ann Arbor, MI. Certification Div.

FORMATION AND CONTROL OF COMBUSTION POLLUTANTS FROM GASOLINE-FUELED SPARK-IGNITION MOTOR VEHICLE ENGINES

John W. Bozek Nov. 1992 59 p
(PB93-141042; EPA/AA/CA/CPSB-90/01) Avail: CASI HC A04/MF A01

The purpose of the report is to provide simple explanations regarding the formation and control of combustion pollutants from gasoline-fueled spark-ignition motor vehicle engines. Formation phenomena are explained on the basis of well-known cause and effect relationships. Pollution control techniques are explained on the basis of the operating characteristics of systems which are already in widespread use. Two appendices are included which present additional information. GRA

N93-23289# Oak Ridge National Lab., TN.

CONTROL AND ANALYSIS OF A SINGLE-LINK FLEXIBLE BEAM WITH EXPERIMENTAL VERIFICATION

J. F. Jansen Dec. 1992 22 p
(Contract DE-AC05-84OR-21400)
(DE93-003756; ORNL/TM-12198) Avail: CASI HC A03/MF A01

The objective of this report is to ascertain the general conditions for the avoidance and reduction of residual vibration in a flexible manipulator. Conventional manipulators usually have a 1.5 to 2-m reach, and their associated dynamic models typically are composed of lumped parameter elements; the major compliance emanates from the drive trains because of torsional loading effects. The energy storage of the drive system is predominantly potential energy because of the low inertia in the drive train; thus simple spring models have been adequate. A long-reach manipulator with a large aspect ratio (length to diameter) is a fundamentally different problem. Energy storage for this type of manipulator is distributive by nature because of the potential energy resulting from bending and the kinetic energy due to deflection rates. Instead of ordinary differential equations, partial differential equations are required to describe this system, making the analysis more difficult. The general flexibility problem associated with a distributive dynamic system, with specific emphasis on flexible manipulator, will be addressed in this report. Furthermore, three control schemes will be discussed and demonstrated on a single flexible manipulator to determine their general merits. DOE

N93-23294# Southern Research Inst., Birmingham, AL.
PATCH TESTING OF CERAMIC BARRIER FILTERS
D. H. Pontius and P. VannBush 1992 6 p Presented at the US DOE Contractors Review Meeting on Coal-Fueled Heat Engines, Advanced PFBC and Gas Stream Cleanup Systems, Morgantown, WV, 27-28 Oct. 1992
(Contract DE-AC21-89MC-26239)
(DE93-005017; DOE/MC-26239/93/C0155; CONF-921034-15) Avail: CASI HC A02/MF A01

The objectives of this work are to construct, install and operate a patch testing unit on a hot gas stream at a coal-fired fluidized-bed boiler. Long-term 'patch tests' will be conducted on ceramic disks of the same materials used in the fabrication of ceramic candles and ceramic crossflow filters. The primary issues to be addressed in these tests are the long-term physical, thermal and chemical stability of the ceramic materials; long-term pressure drop and filtration characteristics of the ceramic filters; potential for irreversible clogging of filter elements; and long-term performance and reliability of auxiliary hardware, such as the tube require about 3 to 4 months of nearly continuous operation. Progress is discussed. DOE

N93-23295# Westinghouse Electric Corp., Pittsburgh, PA. Science and Technology Center.
HIGH TEMPERATURE FILTER MATERIALS
M. A. Alvin, T. E. Lippert, D. M. Bachovchin, and R. E. Tressler (Pittsburgh State Univ., KS.) 1992 22 p Presented at the US DOE Contractors Review Meeting on Coal-Fueled Heat Engines, Advanced PFBC and Gas Stream Cleanup Systems, Morgantown, WV, 27-28 Oct. 1992
(Contract DE-AC21-88MC-25034)
(DE93-005018; DOE/MC-25034/93/C0157; CONF-921034-16) Avail: CASI HC A03/MF A01

Objectives of this program are to identify the potential long-term thermal/chemical effects that advanced coal-based power generating system environments have on the stability of porous ceramic filter materials, as well as to assess the influence of these effects on filter operating performance and life. We have principally focused our efforts on developing an understanding of the stability of the alumina/mullite filter material at high temperature (i.e., 870, 980, and 1100 C) under oxidizing conditions which contain gas phase alkali species. Testing has typically been performed in two continuous flow-through, high temperature test facilities at the Westinghouse Science and Technology Center, using 7 cm diameter times 6.4 mm thick discs. (Alvin, 1992) Each disc of ceramic filter material is exposed for periods of 100 to 3,000 hours in duration. Additional efforts have been performed at Westinghouse to broaden our understanding of the stability of cordierite, cordierite-silicon nitride, reaction and sintered silicon nitride, and clay bonded silicon carbide under similar simulated advanced coal fired process conditions. The results of these efforts are presented in this paper. DOE

N93-23296# Hague International, South Portland, ME.
HIGH-PRESSURE CERAMIC AIR HEATER FOR INDIRECTLY FIRED GAS TURBINE APPLICATIONS
P. G. LaHaye, G. F. Briggs, C. L. Vandervort, and J. L. Seger 1992 10 p Presented at the US DOE Contractors Review Meeting on Coal-Fueled Heat Engines, Advanced PFBC and Gas Stream Cleanup Systems, Morgantown, WV, 27-28 Oct. 1992
(Contract DE-FC21-90MC-26008)
(DE93-005022; DOE/MC-26008/93/C0149; CONF-921034-20) Avail: CASI HC A02/MF A01

The Externally-Fired Combined Cycle (EFCC) offers a method for operating high-efficiency gas and steam turbine combined cycles on coal. In the EFCC, an air heater replaces the gas turbine combustor so that the turbine can be indirectly fired. Ceramic materials are required for the heat exchange surfaces to accommodate the operating temperatures of modern gas turbines. The ceramic air heater or heat exchanger is the focus of this program, and the two primary objectives are (1) to demonstrate that a ceramic air heater can be reliably pressurized to a level of 225 psia (1.5 MPa); and (2) to show that the air heater can withstand exposure to the products of coal combustion at elevated temperatures. By replacing the gas turbine combustor with a ceramic air heater, the cycle can use coal or other ash-bearing fuels. Numerous programs have attempted to fuel high efficiency gas turbines directly with coal, often resulting in significant ash deposition upon turbine components and corrosion or erosion of turbine blades. This report will show that a ceramic air heater is significantly less susceptible to ash deposition or corrosion than a gas turbine when protected by rudimentary methods of gas-stream clean-up. A 25 x 10(sup 6) Btu/hr (7 MW) test facility is under construction in Kennebunk, Maine. It is anticipated that this proof of concept program will lead to commercialization of the EFCC by electric utility and industrial organizations. Applications are being pursued for power plants ranging from 10 to 100 megawatts. DOE

N93-23297# General Electric Co., Schenectady, NY. Power Systems Lab.
HEAVY DUTY GAS TURBINE COMBUSTION TESTS WITH SIMULATED LOW BTU COAL GAS
T. E. Ekstrom, R. A. Battista, and G. P. Maxwell 1992 10 p Presented at the US DOE Contractors Review Meeting on Coal-Fueled Heat Engines, Advanced PFBC and Gas Stream Cleanup Systems, Morgantown, WV, 27-28 Oct. 1992
(Contract DE-FC21-91MC-27221)
(DE93-005078; DOE/MC-27221/93/C0153; CONF-921034-22) Avail: CASI HC A02/MF A01

There is an increasing industry interest in integrated gas turbine combined cycle plants in which coal gasifiers provide the fuel for the gas turbines. Some gasifier plant designs, including the air-blown processes, some integrated oxygen blown processes and some oxygen-blown processes followed by heavy moisturization, produce fuel gases which have lower heating values ranging from 130 to below 100 BTU/scf for which there is little gas turbine combustion experience. This program has the objectives to: Parametrically determine the effects of moisture, nitrogen and carbon dioxide as diluents so that the combustion characteristics of many varieties of gasification product gases can be reasonably predicted without physically testing each specific gas composition; determine emissions characteristics including NO(x), CO, levels etc. associated with each of the diluents; operate with two syngas compositions; DOE chosen air-blown and integrated oxygen-blown, to confirm that the combustion characteristics are in line with predictions; determine if 'logical' refinements to the fuel nozzle will yield improved performance for LBTU fuels; determine the conversion rate of ammonia to NO(x); determine the effects of methane inclusion in the fuel. DOE

N93-23322# Battelle Columbus Labs., OH.
DEVELOPMENT OF THE NESTED FIBER FILTER
R. D. Litt, H. N. Conkle, and J. K. Raghavan 1992 6 p Presented at the US DOE Contractors Review Meeting on Coal-Fueled Heat Engines, Advanced PFBC and Gas Stream Cleanup Systems, Morgantown, WV, 27-28 Oct. 1992
(Contract DE-AC21-89MC-26233)
(DE93-005015; DOE/MC-26233/93/C0167; CONF-921034-13) Avail: CASI HC A02/MF A01

Battelle has tested the Nested Fiber Filter (NFF) as a particulate control device for high temperature, high-pressure (HTHP) applications. Battelle funded initial bench-scale tests which were the basis for patents and a concept applying the NFF. Subsequent parametric tests in a 6-inch diameter reactor established excellent particulate capture performance, greater than 99 percent, for conditions up to 1600 F and 6 atmospheres. Effective cleaning/regeneration of the NFF was achieved in the 6-inch scale with acoustic and mechanical vibration. A pulse combustor was tested in an integrated NFF arrangement because of compatibility with the HTBP conditions. This arrangement provided the basis for larger scale tests under the subject contract. A 6-sq ft test module was designed and installed with an existing fluidized bed combustor for additional development and testing. DOE

N93-23335# Argonne National Lab., IL.
DYNAMIC STABILITY OF MAGLEV SYSTEMS
Y. Cai, S. S. Chen, T. M. Mulcahy, and D. M. Rote Apr. 1992 45 p
(Contract W-31-109-eng-38)
(DE93-004796; ANL-92/21) Avail: CASI HC A03/MF A01

Because dynamic instability is not acceptable for any commercial maglev systems, it is important to consider this phenomenon in the development of all maglev systems. The stability of maglev systems is considered based on experimental data, scoping calculations, and simple mathematical models. Divergence and flutter are obtained for coupled vibration of a three-degree-of-freedom maglev vehicle on a guideway consisting of double

L-shaped aluminum segments attached to a rotating wheel. The theory and analysis developed identifies basic stability characteristics and future research needs of maglev systems. DOE

N93-23336# EG and G Energy Measurements, Inc., Idaho Falls.
DEVELOPMENT OF TEST PROCEDURES FOR HYBRID/ELECTRIC VEHICLES
A. F. Burke Jul. 1992 75 p Revised
(Contract DE-AC07-76ID-01570)
(DE93-005179; DOE/ID-10385; INEL/MISC-92055) Avail: CASI HC A04/MF A01

The development of procedures for testing of hybrid/electric vehicles to determine their energy consumption and emissions characteristics is addressed. Special emphasis is given to hybrid vehicles, which can be operated above some minimum battery state-of-charge in an all-electric mode for all types of driving (city and highway). When the all-electric range of these vehicles is exceeded, the vehicles are operated in the hybrid mode, in which an engine/generator is turned on to generate electricity on-board the vehicle. Key issues in testing hybrid vehicles are identified and discussed. These issues include the test cycles to be used, the instrumentation required, the effect of battery state-of-charge and control strategy in the hybrid mode on the need for repeated test cycles, and the data to be collected and how that data from repeated cycles is interpreted to determine the vehicle energy consumption and emissions characteristics. DOE

N93-23377# Technische Univ., Delft (Netherlands). Vehicle Research Lab.
SEMI-ACTIVE SUSPENSION FOR AUTOMOTIVE APPLICATION
Paul J. T. Venhovens and Alex R. deVlugt (Volvo Car B.V., Helmond, Netherlands.) 1991 31 p Presented at International Conference of Automobile Engineeering Students and Young Automobile Engineers, Prague, Czechoslovakia, 10-14 Sep. 1991
(MEMT-17; ISBN-90-370-0059-2; ETN-93-92010) Copyright Avail: CASI HC A03/MF A01

The theoretical considerations for semi-active damping system evaluation, with respect to semi-active suspension and Kalman filtering, are discussed in terms of the software. Some prototype hardware developments are proposed. A significant improvement in ride comfort performance can be obtained, indicated by root mean square body acceleration values and frequency responses, using a switchable damper system with two settings. Nevertheless the improvement is accompanied by an increase in dynamic tire load variations. The main benefit of semi-active suspensions is the potential of changing the low frequency section of the transfer function. In practice this will support the impression of extra driving stability. It is advisable to apply an adaptive control strategy like the (extended) skyhook version switching more to the 'comfort' setting for straight (and smooth/moderate roughness) road running and switching to 'road holding' for handling maneuvers and possibly rough roads and discrete, severe events like potholes. ESA

N93-23477# Orincon Corp., La Jolla, CA.
CONDITION BASED MACHINERY MAINTENANCE (HELICOPTER FAULT DETECTION), PHASE 1 Final Report
T. W. Brotherton and T. G. Pollard 29 Jan. 1993 42 p LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(Contract N00014-92-C-0059)
(AD-A259774) Avail: CASI HC A03/MF A01

A problem of current interest to the Navy is the automatic detection and classification of faults in mechanical systems such as the transmissions, gearboxes, and bearings of helicopters. The problem is important for both economic and safety reasons. Using automated fault detection and classification, machinery repair can be undertaken as needed and can prevent catastrophic failure. This condition-based maintenance approach is more efficient and cost-effective than the use of predetermined maintenance schedules. Additionally, automated fault detection and classification systems can alert machinery operators, such as helicopter pilots, of the onset of a mechanical problem, thus allowing the pilot to take precautions, such as landing the aircraft, before a potentially catastrophic failure occurs. GRA

N93-23675# Allied-Signal Aerospace Co., Kansas City, MO. Kansas City Div.
THE DETERMINATION OF PARTICULATE CONTAMINATION IN MINIATURE BALL BEARINGS
W. B. Harding Dec. 1992 10 p
(Contract DE-AC04-76DP-00613)
(DE93-006261; KCP-613-5002) Avail: CASI HC A02/MF A01

A method is described for determining the particulate contamination in miniature ball bearings in which the bearing is flushed with a solvent that is then filtered. The particles that are collected on the filter are examined by optical microscopy. DOE

N93-23694# Sandia National Labs., Livermore, CA.
IMAGING TECHNIQUE FOR WELDING STUDIES
A. R. Pomplun Nov. 1992 22 p
(Contract DE-AC04-76DR-00789)
(DE93-006449; SAND-93-8205) Avail: CASI HC A03/MF A01

The application of standard imaging techniques for arc welding processes does not provide the data required to construct and verify welding models. The intense luminance range of the arc exceeds the dynamic response of film emulsions and electronic sensors. A diagnostic imaging technique which uses laser illumination and narrow band pass filters in conjunction with high speed film and video systems provides detailed experimental data for welding process modeling. DOE

N93-23741*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PATTERN CLASSIFIER FOR HEALTH MONITORING OF HELICOPTER GEARBOXES
Hsinyung Chin (Massachusetts Univ., Amherst.), Kourosh Danai (Massachusetts Univ., Amherst.), and David G. Lewicki Apr. 1993 15 p Proposed for presentation at the 47th Meeting of the Mechanical Failures Prevention Group, Virginia Beach, VA, 13-15 Apr. 1993; sponsored by ONR
(RTOP 505-62-10; DA Proj. 1L1-62211-A-47-A)
(NASA-TM-106099; E-7741; NAS 1.15:106099; AVSCOM-TR-92-C-033)
Avail: CASI HC A03/MF A01

The application of a newly developed diagnostic method to a helicopter gearbox is demonstrated. This method is a pattern classifier which uses a multi-valued influence matrix (MVIM) as its diagnostic model. The method benefits from a fast learning algorithm, based on error feedback, that enables it to estimate gearbox health from a small set of measurement-fault data. The MVIM method can also assess the diagnosability of the system and variability of the fault signatures as the basis to improve fault signatures. This method was tested on vibration signals reflecting various faults in an OH-58A main rotor transmission gearbox. The vibration signals were then digitized and processed by a vibration signal analyzer to enhance and extract various features of the vibration data. The parameters obtained from this analyzer were utilized to train and test the performance of the MVIM method in both detection and diagnosis. The results indicate that the MVIM method provided excellent detection results when the full range of faults effects on the measurements were included in training, and it had a correct diagnostic rate of 95 percent when the faults were included in training. Author

N93-23966 National Research Council of Canada, Ottawa (Ontario).
END EFFECTORS AND GRAPPLE FIXTURES Patent
Ron Vandersluis, inventor (to National Research Council of Canada and Erik Quittner, inventor (to National Research Council of Canada 28 Jan. 1992 44 p Filed 28 Sep. 1987
(CA-Patent-1-294-917; Int-Patent-Class-B25J-19/00; Int-Patent-Class-B64G-1/64; CTN-93-60634) Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC

An end effector has been developed for use with a space station remote manipulator system where capture and release capabilities are required, and which will provide for the transfer of substantial loads together with electrical power and signals across the end effector grapple fixture interface. The end effector has a latching mechanism for the transfer of substantial loads across the end effector grapple fixture interface. The functions associated with known nonlatching end effectors, namely their snaring and rigidizing capabilities, are maintained and can be operated

independently of the new latching mechanisms and umbilical connectors of the end effector. The end effector is capable of functioning equally as a wrist (manipulator) and shoulder (arm base) unit. Applications of the new end effector include space station assembly, payload handling, capture of free-flyers, payload servicing, and providing stable bases for extravehicular activity work stations or robotic devices. Author (CISTI)

N93-23967 National Research Council of Canada, Ottawa (Ontario).
GRAPPLE FIXTURE Patent
Ron Vandersluis, inventor (to National Research Council of Canada and Erik Quittner, inventor (to National Research Council of Canada 17 Mar. 1992 42 p Filed 23 Mar. 1990
(CA-Patent-1-297-519; Int-Patent-Class-B25J-19/00; Int-Patent-Class-B64G-1/64; CTN-93-60670) Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC

A grapple fixture is disclosed which is capable of use in a space station assembly, payload handling functions, capture of free flyers, assisting in payload servicing, and providing a stable base for extravehicular activity work stations or robotic devices. In particular, the grapple fixture of the invention may be located on a mobile servicing center, a maintenance depot or any other space station installation. The fixture is also able to support the space station remote manipulator system. The fixture comprises a base consisting of a mounting flange with an outwardly extending cylindrical body having an outer annular end effector abutment face; an end effector latching trunnion attached to the cylindrical body of the base; a cone-shaped aligning body extending outwardly from the cylindrical body; and a fixture recess engaging shoulder extending around part of the cylindrical base and secured against relative movement to the abutment face.
Author (CISTI)

N93-23976# Argonne National Lab., IL.
TAGUCHI METHODS APPLIED TO OXYGEN-ENRICHED DIESEL ENGINE EXPERIMENTS
W. W. Marr, R. R. Sekar, R. L. Cole, T. J. Marciniak, and D. E. Longman (AutoResearch Labs., Inc., Chicago, IL.) 1992 5 p Presented at the 16th Annual Energy-sources Technology Conference and Exhibition, Houston, TX, 25 Jan. - 4 Feb. 1993
(Contract W-31-109-eng-38)
(DE93-004873; ANL/CP-77378; CONF-930124-2) Avail: CASI HC A01/MF A01

This paper describes a test series conducted on a six-cylinder diesel engine to study the impacts of controlled factors (i.e., oxygen content of the combustion air, water content of the fuel, fuel rate, and fuel-injection timing) on engine emissions using Taguchi methods. Three levels of each factor were used in the tests. Only the main effects of the factors were examined; no attempt was made to analyze the interactions among the factors. It was found that, as in the case of the single-cylinder engine tests, oxygen in the combustion air was very effective in reducing particulate and smoke emissions. Increases in NO(sub x) due to the oxygen enrichment observed in the single-cylinder tests also occurred in the present six-cylinder tests. Water in the emulsified fuel was found to be much less effective in decreasing NO(sub x) emissions for the six-cylinder engine than it was for the single-cylinder engine. DOE

N93-24007# ABB Power Generation, Inc., North Brunswick, NJ. Turbine Power Div.
ADVANCED TURBINE DESIGN PROGRAM
S. vanderLinden, G. Gnaedig, and F. Kreitmeier 1992 14 p Presented at the 9th Annual Coal-Fueled Heat Engines, Advanced Pressurized Fluidized Bed Combustion (PFBC) and Gas Stream Cleanup Systems Contractors Review Meeting, Morgantown, WV, 27-29 Oct. 1992; sponsored by DOE
(Contract DE-AC21-92MC-29234)
(DE93-005077; DOE/MC-29234/93/C0160; CONF-921034-23) Avail: CASI HC A03/MF A01

The prime objective of this project task is to select a natural gas fired Advanced Turbine System (ATS) capable of reaching 60 percent cycle efficiency. Several cycles were compared and evaluated under all different kind of aspects, to determine the one with the highest potential and, at the same time, the best overall fit within and experience base to guarantee project goals. The combined cycle with multistep development potential was identified as the system to reach the 60 percent or greater thermal efficiency. DOE

N93-24049# Westinghouse Hanford Co., Richland, WA.
A NEW APPROACH FOR HELIUM BACKFILLING AND LEAK TESTING SEAL-WELDED CAPSULES IN A HOT CELL
E. K. Strasslsund and D. N. Berger (Pacific Northwest Lab., Richland, WA.) May 1992 5 p Presented at the American Nuclear Society Annual Meeting, Boston, MA, 7-12 Jun. 1992
(Contract DE-AC06-87RL-10930)
(DE93-004519; WHC-SA-1496; CONF-920606-41) Avail: CASI HC A01/MF A01

Gamma irradiation sources containing radioactive Cesium-137 Chloride are being produced at the U.S. Department of Energy's Hanford Site as part of a Westinghouse Hanford company/Pacific Northwest Laboratory cooperative program. New equipment was developed to leak test the double-encapsulated sources in a hot cell. The equipment, which includes a helium backfill chamber and end cap press, a vacuum chamber, and a helium mass spectrometer, has provided technicians with the capability to detect leaks in sealed sources as small as 1.0 x 10(exp -7) atm cu cm/S helium. DOE

N93-24145# Energy International, Inc., Bellevue, WA.
ASSESSMENT OF FUTURE NATURAL GAS VEHICLE CONCEPTS Final Report, Oct. 1991 - Jul. 1992
B. Groten and S. Arrigotti Oct. 1992 70 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5091-260-2201)
(PB93-138923; Rept-9188R365; GRI-92/0433) Avail: CASI HC A04/MF A01

The development of Natural Gas Vehicles is progressing rapidly under the stimulus of recent vehicle emission regulations. The development is following what can be viewed as a three step progression. In the first step, contemporary gasoline or diesel fueled automobiles are retrofitted with equipment enabling the vehicle to operate on either natural gas or standard liquid fuels. The second step is the development of vehicles which utilize traditional internal combustion engines that have been modified to operate exclusively on natural gas. These dedicated natural gas vehicles operate more efficiently and have lower emissions than the dual fueled vehicles. The third step is the redesigning, from the ground up, of a vehicle aimed at exploiting the advantages of natural gas as an automotive fuel while minimizing its disadvantages. The current report is aimed at identifying the R&D needs in various fuel storage and engine combinations which have potential for providing increased efficiency, reduced emissions, and reductions in vehicle weight and size. Fuel suppliers, automobile and engine manufacturers, many segments of the natural gas and other industries, and regulatory authorities will influence or be affected by the development of such a third generation vehicle, and it is recommended that GRI act to bring these groups together in the near future to begin, developing the focus on a 'designed-for-natural-gas' vehicle. GRA

N93-24152# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
UNDERSTANDING AND MODELING THE BEHAVIOR OF A HARMONIC DRIVE GEAR TRANSMISSION
Timothy D. Tuttle May 1992 317 p
(Contract N00014-86-K-0685)
(AD-A259610; AI-TR-1365) Avail: CASI HC A14/MF A03

As harmonic-drive transmissions find increased use and acceptance among engineers and designers, the demand for an accurate and reliable understanding of harmonic-drive operating behavior becomes great. I performed an extensive experimental investigation of harmonic-drive properties such as stiffness, friction, and kinematic error. From my experimental results, I have confirmed that kinematic error appears primarily at frequencies that are multiples of the wave-generator rotational speed and that transmission stiffness can be highly non-linear. Additionally, measurements of static and dynamic friction demonstrated that energy dissipation in harmonic drives varies non-linearly with velocity and periodically with rotation and can escalate during system resonance. Due to the interaction of these transmission properties, dynamic response measurements showed surprisingly agitated behavior, especially around system resonance. This behavior was rationalized in terms of the observed

properties and used to develop dynamic models to describe harmonic-drive operation. From these models, I realized that non-linear frictional effects cannot be ignored in any accurate representation. Additionally, if behavior around system resonance must be replicated, both kinematic error and compliant behavior are essential. GRA

N93-24182 Ohio State Univ., Columbus.
MODELING AND CONTROL OF FLEXIBLE MANIPULATORS Ph.D. Thesis
Zhijie Xia 1992 216 p
Avail: Univ. Microfilms Order No. DA9238302

The modeling and control of flexible manipulators are investigated. It contributes to three areas: (1) the tracking control of nonminimum phase systems; (2) modeling and control of flexible one-link manipulators; and (3) modeling and control of flexible multi-link manipulators. The characteristics of the discrete-time nonminimum phase zeros are first analyzed, and a precision tracking control method for nonminimum phase systems is proposed. The proposed precision tracking controller cancels all the phase shift of the nonminimum phase zeros and minimizes their gain errors within the concerned frequency range. The second part of the research is the modeling and control of flexible one-link manipulators. A reduced order finite element model is presented, and the system transfer functions are constructed. A real time end-point tracking control scheme is developed by applying the proposed precision tracking control method. A payload adaptation algorithm is proposed to identify the payload variation, and an adaptive tracking control algorithm is formulated. Based on the understanding from the study of flexible one-link manipulators, the modeling and control of flexible multi-link manipulators are investigated. An accurate system model, which includes the mutual dependence of the rigid and the elastic motion as well as the effects of the elastic deformation on the transformation matrix, is proposed for general planar flexible manipulators. To reduce the amount of computations in the dynamic analysis, a model reduction technique is developed, in which the dominant modes of the system as well as the time variant nature of the mode shape functions remain. Consequently, the required computation for dynamic analysis is greatly reduced while the accuracy of the system response is maintained. The end-point tracking control of a flexible manipulator is also investigated. A time-varying estimator is designed to estimate the system elastic deformation. Using the desired end-point motion and the estimated system elastic motion, a tracking control scheme, which consists of a feedback controller, a command feedforward controller, and an elastic motion estimator, is proposed. The proposed tracking control algorithm is very efficient and can be implemented for real time control. Dissert. Abstr.

N93-24184# Illinois Univ., Chicago.
TRAJECTORY CONTROL OF AN ARTICULATED ROBOT WITH A PARALLEL DRIVE ARM BASED ON SPLINES UNDER TENSION Ph.D. Thesis
Seung-Jong Yi 1992 204 p
Avail: Univ. Microfilms Order No. DA9238369

Today's industrial robots controlled by mini/micro computers are basically simple positioning devices. The positioning accuracy depends on the mathematical description of the robot configuration to place the end-effector at the desired position and orientation within the workspace and on following the specified path which requires the trajectory planner. In addition, the consideration of joint velocity, acceleration, and jerk trajectories are essential for trajectory planning of industrial robots to obtain smooth operation. The newly designed 6 DOF articulated robot with a parallel drive arm mechanism which permits the joint actuators to be placed in the same horizontal line to reduce the arm inertia and to increase load capacity and stiffness is selected. First, the forward kinematic and inverse kinematic problems are examined. The forward kinematic equations are successfully derived based on Denavit-Hartenberg notation with independent joint angle constraints. The inverse kinematic problems are solved using the arm-wrist partitioned approach with independent joint angle constraints. Three types of curve fitting methods used in trajectory planning, i.e., certain degree polynomial functions, cubic spline functions, and cubic spline functions under tension, are compared to select the best possible method to satisfy both smooth joint trajectories and positioning accuracy for a robot trajectory planner. Cubic spline functions under tension is the method selected for the new trajectory planner. This method is implemented for a 6 DOF articulated robot with a parallel drive arm mechanism to improve the smoothness of the joint trajectories and the positioning accuracy of the manipulator. Also, this approach is compared with existing trajectory planners, 4-3-4 polynomials and cubic spline functions, via circular arc motion simulations. The new trajectory planner using cubic spline functions under tension is implemented into the microprocessor based robot controller and motors to produce combined arc and straight-line motion. The simulation and experiment show interesting results by demonstrating smooth motion in both acceleration and jerk and significant improvements of positioning accuracy in trajectory planning. Author

N93-24218 Illinois Univ., Chicago.
KINEMATICS AND DYNAMICS OF ROBOTIC SYSTEMS WITH MULTIPLE CLOSED LOOPS Ph.D. Thesis
Chang-De Zhang 1992 328 p
Avail: Univ. Microfilms Order No. DA9238371

The kinematics and dynamics of robotic systems with multiple closed loops, such as Stewart platforms, walking machines, and hybrid manipulators, are studied. In the study of kinematics, focus is on the closed-form solutions of the forward position analysis of different parallel systems. A closed-form solution means that the solution is expressed as a polynomial in one variable. If the order of the polynomial is less than or equal to four, the solution has analytical closed-form. First, the conditions of obtaining analytical closed-form solutions are studied. For a Stewart platform, the condition is found to be that one rotational degree of freedom of the output link is decoupled from the other five. Based on this condition, a class of Stewart platforms which has analytical closed-form solution is formulated. Conditions of analytical closed-form solution for other parallel systems are also studied. Closed-form solutions of forward kinematics for walking machines and multi-fingered grippers are then studied. For a parallel system with three three-degree-of-freedom subchains, there are 84 possible ways to select six independent joints among nine joints. These 84 ways can be classified into three categories: Category 3:3:0, Category 3:2:1, and Category 2:2:2. It is shown that the first category has no solutions; the solutions of the second category have analytical closed-form; and the solutions of the last category are higher order polynomials. The study is then extended to a nearly general Stewart platform. The solution is a 20th order polynomial and the Stewart platform has a maximum of 40 possible configurations. Also, the study is extended to a new class of hybrid manipulators which consists of two serially connected parallel mechanisms. In the study of dynamics, a computationally efficient method for inverse dynamics of manipulators based on the virtual work principle is developed. Although this method is comparable with the recursive Newton-Euler method for serial manipulators, its advantage is more noteworthy when applied to parallel systems. An approach of inverse dynamics of a walking machine is also developed, which includes inverse dynamic modeling, foot force distribution, and joint force/torque allocation. A new approach is then proposed to determine the foot distribution of planar walking gaits based on two optimum criteria. A computational scheme is then developed to determine the joint force/torque allocation, on the basis of the virtual work principle. As an illustration, the inverse dynamic modeling of a quadruped with pantograph legs is derived. The inverse dynamics of this quadruped walking in different wave gaits is then studied. Dissert. Abstr.

N93-24220# Department of the Navy, Washington, DC.
WRENCH FOR INSTALLING AN ELECTRICAL CONNECTOR Patent Application
Norman F. Willett, inventor (to Navy) 26 Oct. 1992 22 p
(AD-D015625; US-Patent-Appl-SN-966478; Navy-Case-74663) Avail: CASI HC A03/MF A01

A wrench for installing or removing an electrical connector having a collar is provided. The wrench comprises two handles, an elongated sleeve, a shaft, a cam, and a grip. One end of the elongated sleeve slidably attaches to a hub of the grip while the other end slidably attaches to the first handle. The grip further comprises a semicircular-shaped claw which engages the collar of the electrical connector. The shaft is rotatably disposed within the interior of the sleeve. One end of the shaft is eccentrically connected to the cam and the other end is connected to the second handle. The second handle is positioned within an aperture of the first handle. During operation of the wrench, the user grasps both handles and maneuvers the wrench between a series of cables on one side of an electric terminal assembly having a plurality of interconnected cables until

the grip is positioned over the collar of a connector of a selected electrical cable. The second handle is then rotated for the purpose of gripping the collar between the claw and the cam. GRA

N93-24256# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
A COMPARATIVE ANALYSIS OF ALTERNATIVE FUELS FOR THE INEL VEHICLE FLEET
S. Priebe, W. Boyer, and K. Church Nov. 1992 56 p
(Contract DE-AC07-76ID-01570)
(DE93-007224; EGG-EP-10500) Avail: CASI HC A04/MF A01

This report summarizes the results of a comparative systems analysis of various alternative fuels for use in the buses, mid-size vehicles, and automobiles that make up the vehicle fleet at the Idaho National Engineering Laboratory (INEL). The study was performed as part of the Laboratory Directed Research and Development (LDRD) Program for EG&G Idaho, Inc. Regulations will require the INEL to reduce total gasoline and diesel fuel use 10 percent by 1995 compared with 1991 levels, and will require that 50 percent of all new vehicles be fueled by some type of alternative fuel by 1998. A model was developed to analyze how these goals could be achieved, and what the cost would be to implement the goals. DOE

N93-24287# National Research Council of Canada, Ottawa (Ontario). Inst. for Mechanical Engineering.
[ACTIVITIES OF THE INSTITUTE FOR MECHANICAL ENGINEERING] Annual Report, 1991-1992
1992 52 p
(NRC-33578; CTN-93-60705) Copyright Avail: CASI HC A04/MF A01

The Institute of Mechanical Engineering (IME) is part of Canada's National Research Council. Its mission is to undertake, support, promote, and disseminate research and development in the mechanical engineering aspects of three vital sectors of the Canadian economy: transportation, resource industries, and manufacturing. The IME achieves its mission by performing research and development in its own facilities; by developing, providing, and transferring expertise and knowledge; by making its research facilities available to collaborators and clients; and by participating in international liaison and collaborative research activities. Six research programs are conducted in the IME: Advanced Manufacturing Technology; Coastal Zone Engineering; Cold Regions Engineering; Combustion and Fluids Engineering; Ground Transportation Technology; and Machinery and Engine Technology. The rationale and major research thrusts of each program are described, and specific achievements in 1991-92 are reviewed. Lists of technical reports and papers presented by IME personnel are also included. CISTI

N93-24442# Computational Mechanics Co., Austin, TX.
NEW MICRO- AND MACROSCOPIC MODELS OF CONTACT AND FRICTION Annual Technical Report No. 2, 1 Nov. 1991 - 31 Oct. 1992
W. W. Tworzydlo, W. Cecot, J. T. Oden, and C. H. Yew 25 Nov. 1992 105 p
(Contract F49620-91-C-0011)
(AD-A259925; TR-92-15; AFOSR-93-0008TR) Avail: CASI HC A06/MF A02

Work in the second year of a project devoted to the development of new asperity-based models of frictional interfaces is summarized. The main concept is to combine statistical homogenization methods with a realistic nonlinear finite element analysis of surface asperities, and thus produce new asperity-based models of contact and friction. The research in the first year of the project provided a complete theory and software for statistical homogenization of random surface parameters. In the second year of the project, the effort focused on the development of a finite element code for modeling of nonelastic surface asperities, as well as on the design and performance of the verification experiment. The asperity modeling code is based on an hp adaptive finite element kernel, with object-based data structure, error estimation, and graphic user interface. The code is capable of modeling elastic and elasto-viscoplastic solids in contact with a rigid flat. In parallel with the code development, an experiment was designed and performed for custom-made asperities in contact with rigid surfaces. The results of these experiments compare favorably with numerical predictions of the finite element method. Finally, the results of the finite element analysis were used to construct the first asperity-based contact model of random surface. GRA

N93-24444# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
ELECTRIC AND HYBRID VEHICLE PROGRAM; SITE OPERATOR PROGRAM
J. F. Warren May 1992 62 p
(Contract DE-AC07-76ID-01570)
(DE93-005239; EGG-EP-10295) Avail: CASI HC A04/MF A01

Activities during the second quarter included the second meeting of the Site Operators in Phoenix, AZ in late April. The meeting was held in conjunction with the Solar and Electric 500 Race activities. Delivery of vehicles ordered previously has begun, although two of the operators are experiencing some delays in receiving their vehicles. Public demonstration activities continue, with an apparent increasing level of awareness and interest being displayed by the public. Initial problems with the Site Operator Database have been corrected and revised copies of the program have been supplied to the program participants. Operating and Maintenance data is being supplied and submitted to INEL on a monthly basis. Interest in the Site Operator Program is being reflected in requests for information from several organizations from across the country, representing a wide diversity of interests. These organizations have been referred to existing Site Operators with the explanation that the program will not be adding new participants, but that most of the existing organizations are willing to work with other groups. The exception to this was the addition of Potomac Electric Power Company (PEPCO) to the program. PEPCO has been awarded a subcontract to operate and maintain the DOE owned G-Van and Escort located in Washington, DC. They will provide data on these vehicles, as well as a Solectria Force which PEPCO has purchased. The Task Force intends to be actively involved in the infrastructure development in a wide range of areas. These include, among others, personnel development, safety, charging, and servicing. Work continues in these areas. York Technical College (YORK) has completed the draft outline for the EV Technician course. This is being circulated to organizations around the country for comments. Kansas State University (KSU) is working with a private sector company to develop a energy dispensing meter for opportunity charging in public areas. DOE

N93-24446# Argonne National Lab., IL. Chemical Technology Div.
ANL'S ELECTRIC VEHICLE BATTERY ACTIVITIES FOR USABC
1992 17 p Prepared in cooperation with United States Advanced Battery Consortium
(Contract W-31-109-eng-38)
(DE93-005691; ANL/CMT/RP-78324) Avail: CASI HC A03/MF A01

The Electrochemical Technology Program at Argonne National Laboratory (ANL) provides advanced battery R&D; technology transfer to industry; technical analyses, assessments, modeling, and databases; and independent testing and post-test analyses of advanced batteries. These capabilities and services are being offered to the US Advanced Battery Consortium (USABC) and Cooperative Research and Development Agreements (CRADA) are being negotiated for USABC-sponsored work at ANL. A small portion of DOE's cost share for USABC projects has been provided to ANL to continue R&D and testing activities on key technologies that were previously supported directly by DOE. This report summarizes progress on these USABC projects during the period of April 1 through September 30, 1992. In this report, the objective, background, technical progress, and status are described for each task. The work is organized into the following task areas: 1.0 Lithium/Sulfide Batteries; 2.0 Nickel/Metal Hydride Support 3.0 EV Battery Performance; and Life Evaluation. DOE

N93-24561# Tecogen, Inc., Waltham, MA.
VARIABLE SPEED GAS ENGINE-DRIVEN AIR COMPRESSOR SYSTEM Final Technical Report, Oct. 1989 - Dec. 1991
J. R. Morgan, A. E. Ruggles, T. N. Chen, and J. Gehret Nov. 1992 247 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5089-291-1846)
(PB93-147353; TR4489-010-92; GRI-92/0414) Avail: CASI HC A11/MF A03

Tecogen Inc. and Ingersoll-Rand Co. as a subcontractor have designed a nominal 150-hp gas engine-driven air compressor utilizing the TECODRIVE 8000 engine and the Ingersoll-Rand 178.5-mm twin screw compressor. Phase 1 included the system engineering and design, economic and applications studies, and a draft commercialization plan. Phase 2 included controls development, laboratory prototype construction, and performance

testing. The testing conducted verified that the compressor meets all design specifications. GRA

N93-24586# General Atomic Co., San Diego, CA.
ADVANCED POWER CONDITIONING FOR MAGLEV SYSTEMS Final Report
A. Nerem, E. E. Bowles, S. Chapelle, and R. J. Callanan Aug. 1992 361 p Sponsored by Federal Railroad Administration
(Contract DTFR53-91-C-00081)
(PB93-150274; GA-A20986; DOT/FRA/NMI-92/14) Avail: CASI HC A16/MF A03

The final report contains parametric scaling data and computer models of power conditioning equipment applicable to the design of an advanced maglev system. The power conditioning topologies were selected based on data from a literature search, on characteristics of present power semiconductor technology devices, and on actual performance characterization of designs using a circuit analysis program. The analyses show that GTO's are the best switches for traction drives, input power conditioning equipment, and the braking chopper. At lower power levels, as required for auxiliary power and superconducting coil power conditioning, the IGBT appeared to be the best switch. GRA

N93-24595# National Center for Earthquake Engineering Research, Buffalo, NY.
EXPERIMENTAL AND ANALYTICAL STUDY OF A HYBRID ISOLATION SYSTEM USING FRICTION CONTROLLABLE SLIDING BEARINGS
M. Q. Feng, M. Shinozuka, and S. Fujii 15 May 1992 101 p Sponsored by NSF Prepared in cooperation with Princeton Univ., NJ, and Taisei Corp., Tokyo
(Contract NSF BCS-90-25010; NEC-91029)
(PB93-150282; NCEER-92-0009) Avail: CASI HC A06/MF A02

A hybrid sliding isolation system (HBIS) using friction controllable sliding bearings is studied. The system controls the friction force on the sliding interface between the supported structure and the ground, by adjusting the pressure in a bearing chamber, to confine the sliding displacement within an acceptable range, while keeping the transfer of seismic force to a minimum. Instantaneous optimal control and bang-bang control algorithms are developed for controlling the friction force. The effectiveness of the algorithms is demonstrated by shaking table experiments and computer simulation. An HBIS using friction controllable bearings is fabricated and shaking table experiments are performed using a rigid structural model equipped with such a hybrid system. The dynamic characteristics of the control system for bearing pressure and sliding friction are identified, and the advantage of the HBIS over the passive system is demonstrated by experiments. Computer codes for simulation of structural response under passive or hybrid control are developed. The numerically simulated results show good agreement with the experimental results, verifying that the analytical model developed represents the actual system very well. GRA

N93-24628# Environmental Protection Agency, Ann Arbor, MI. Office of Mobile Sources.
EVALUATION OF AN EMITEC RESISTIVELY HEATED METAL MONOLITH CATALYTIC CONVERTER ON TWO M100 NEAT METHANOL-FUELED VEHICLES
Gregory K. Piotrowski and Ronald M. Schaefer Dec. 1992 31 p
(PB93-141059; EPA/AA/CTAB-92/04) Avail: CASI HC A03/MF A01

The report describes the evaluation of a resistively heated catalyst system on two different methanol fueled vehicles. The EMITEC catalyst consisted of a compact resistively heated metal monolith in front of a larger conventional main converter. The EMITEC catalyst was evaluated on two neat methanol-fueled vehicles, a 1981 Volkswagen Rabbit and a 1988 Toyota Corolla. Emission testing was conducted over the Federal Test Procedure (FTP) CVS-75 test cycle. The emissions of primary interest were cold start methanol (unburned fuel), carbon monoxide, and formaldehyde. GRA

N93-24656*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
A GLOBAL PATH PLANNING APPROACH FOR REDUNDANT MANIPULATORS
Sanjeev Seereeram and J. Wen Jan. 1993 59 p
(Grant NAGw-1333)
(NASA-CR-193017; NAS 1.26:193017; RPI-CIRSSE-127) Avail: CASI HC A04/MF A01

A new approach for global path planning of redundant manipulators is proposed. It poses the path planning problem as a finite time nonlinear control problem. The solution is found by a Newton-Raphson type algorithm. This technique is capable of handling various goal task descriptions as well as incorporating both joint and task space constraints. The algorithm has shown promising preliminary results in planning joint path sequences for 3R and 4R planar robots to meet Cartesian tip tracking and goal endpoint planning. It is robust with respect to local path planning problems such as singularity considerations and local minimum problems. Repetitive joint path solutions for cyclic end-effector tasks are also generated. Eventual goals of this work include implementation on full spatial robots, as well as provision of an interface for supervisory input to aid in path planning for more complex problems. Author

N93-24658*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
PETRI NET CONTROLLERS FOR DISTRIBUTED ROBOTIC SYSTEMS
D. R. Lefebvre and George N. Saridis Sep. 1992 14 p
(Grant NAGw-1333)
(NASA-CR-193196; NAS 1.26:193196; RPI-CIRSSE-126) Avail: CASI HC A03/MF A01

Petri nets are a well established modelling technique for analyzing parallel systems. When coupled with an event-driven operating system, Petri nets can provide an effective means for integrating and controlling the functions of distributed robotic applications. Recent work has shown that Petri net graphs can also serve as remarkably intuitive operator interfaces. In this paper, the advantages of using Petri nets as high-level controllers to coordinate robotic functions are outlined, the considerations for designing Petri net controllers are discussed, and simple Petri net structures for implementing an interface for operator supervision are presented. A detailed example is presented which illustrates these concepts for a sensor-based assembly application. Author (revised)

N93-22181*# Agricultural Research Service, New Orleans, LA.
APPLICATIONS OF FIBROUS SUBSTRATES CONTAINING INSOLUBILIZED PHASE CHANGE POLYMERS
Tyrone L. Vigo and Joseph S. Bruno *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 307-316 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22199*# ARRAL Industries, Inc., Ontario, CA.
A DUAL OUTPUT PRESSURE, HIGH RELIABILITY, LONG STORAGE LIFE GAS DELIVERY VESSEL ASSEMBLY
Isaac Maya, Joe McKee, and Rajiv Rajpurkar *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 470-474 (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

N93-22320*# Logicon Control Dynamics Co., Huntsville, AL.
METHODS FOR MODELING CONTACT DYNAMICS OF CAPTURE MECHANISMS Abstract Only
Philip J. Williams, Patrick A. Tobbe, and John Glaese *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p Sponsored in cooperation with Boeing Aerospace and Electronics Co. (For primary document see N93-22226 08-12)
(Contracts NAS8-36570; NAS8-36417)
Avail: CASI HC A01/MF A03

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N93-22695# Ames Lab., IA.
MICROMAGNETIC SURFACE STUDIES OF MATERIALS FOR NONDESTRUCTIVE EVALUATION Ph.D. Thesis
L. B. Sipahi 25 Nov. 1992 202 p
(Contract W-7405-eng-82)
(DE93-006303; IS-T-1634) Avail: CASI HC A10/MF A03

A system which employs the magnetic Barkhausen effect to measure micromagnetic Barkhausen emissions (E) in ferromagnetic materials using a time varying magnetic field was developed. A patent application was made (US patent application temporary no. 754,904 pending). It was observed that E is dependent on microstructure in different Fe, Ni, Co alloys, steel, and rare earth-Fe alloys. The ac excitation field used in the present developed system is essential, since superposition of ac excitation field on quasi dc field gives cleaner, more reproducible magnetic Barkhausen pulse waveforms. 30 Hz was found optimal for the excitation frequency, for very fast in situ measurements. E can be generated at different depths in the material by altering the excitation frequency; using a band pass filter, E can be detected over different frequency ranges. Instead of conventional count rate, techniques for analyzing the E were developed: pulse height spectrum analysis, frequency spectrum analysis, RMS voltage analysis, and pulse waveform analysis. A model was developed for the magnetic Barkhausen effect. DOE

N93-22727# Ames Lab., IA.
USING NONLINEAR ACOUSTICS FOR NONDESTRUCTIVE MATERIALS CHARACTERIZATION AND EVALUATION
G. E. Dace, O. Buck, and R. B. Thompson 1992 5 p Presented at the Winter Annual Meeting of the ASME, Anaheim, CA, 8-13 Nov. 1992
(Contract W-7405-eng-82)
(DE93-004447; IS-M-727; CONF-921110-35) Avail: CASI HC A01/MF A01

A non-parabolic atomic potential explains a variety of acoustic observations such as stress effects on the sound velocity and acoustic harmonic generation caused by a continuous distortion of the wave. Additional nonlinearities come about by alloying additions and by dislocation vibrations or, in other words, by the initiation of plastic flow. Particularly dramatic are the effects due to the nucleation of a new phase, as well as free and internal surfaces. These observations make nonlinear acoustics a valuable tool for nondestructive materials characterization, particularly since relative changes appear to be roughly an order of magnitude larger than those observed in traditional linear acoustics. Our work is concentrating on using acoustic harmonic generation as the primary measurement. We are developing a technique that measures displacement amplitudes using fluid-coupled contact transducers. First experiments on fused silica to test the system will be followed by the determination of solid solution effects of Cu in Al including the well-known precipitation sequences in this system during thermal aging. DOE

N93-23445# Department of Defense, Washington, DC.
PROCESS MANAGEMENT: THE QUALITY WAY TO IMPROVEMENT
C. D. Hecker Oct. 1992 69 p
(PB93-154532) Avail: CASI HC A04/MF A01

The book is presented as a reference guide for Process Management. It focuses on the fundamental premise that no process, product or service is perfect, and everything can be improved. GRA

N93-23470# Boeing Aerospace and Electronics Co., Seattle, WA.
HIGH RESOLUTION COMPUTED TOMOGRAPHY Interim Report, Aug. 1990 - May 1991
Richard H. Bossi, John L. Cline, and Gary E. Georgeson 31 Jul. 1992 39 p
(Contract F33615-88-C-5404)
(AD-A259728; WL-TR-91-4102) Avail: CASI HC A03/MF A01

High resolution (greater than 4 line pairs per millimeter) computed tomography (CT) was studied for its potential use for engineering evaluation of aerospace components. The CT images provide two dimensional maps of material linear x ray attenuation coefficients for small volume elements, smaller than 0.001 cubic millimeters. These images are similar to micrographic images of polished surfaces from sectioned components, but are achieved nondestructively. For investigating materials where destructive sectioning relieves stresses, changing the internal configuration of features, such as gaps, high resolution CT provides superior diagnostic information for engineering evaluation. The primary benefits of CT are realized in accelerating schedules through faster data acquisition and reducing engineering risk by providing increased information nondestructively. High resolution CT is particularly well suited to assist in failure analysis investigations. Multiple slice or volume reconstruction high resolution CT can provide full three dimensional models. The cost and performance of high resolution CT systems are functions of the component size and ultimate resolution capability. For many common evaluation needs, the capital cost can be as low as a 50 percent cost add-on to a real-time radiographic imaging system. Relative to micrography, CT can be performed in about on-fifth the time, depending on the number of samples. GRA

N93-24020# Army Armament Research, Development and Engineering Center, Watervliet, NY. Benet Lab.
NONDESTRUCTIVE EVALUATION OF ELECTRODEPOSITED CHROMIUM Final Report
Mark E. Todaro Nov. 1992 16 p
(AD-A259884; ARCCB-TR-92046) Avail: CASI HC A03/MF A01

Benet Laboratories is pursuing methods for nondestructively evaluating the quality and adhesion of electrodeposited chromium coatings on the bore of large caliber gun tubes. The Army currently has no suitable means for testing such coatings nondestructively. A poor quality or poorly adherent coating shows up only when several test rounds are fired through the tube, removing portions of the coating and exposing the steel underneath. Recent in-house work has investigated both photothermal and ultrasonic methods. The photothermal method involves briefly heating the surface of the chromium with a laser pulse. After the initial heating, the surface temperature decreases as heat diffuses into the coating and substrate. The characteristics of the coating, interface, and substrate affect the surface temperature profile in distinct ways. The temperature of the surface can be measured by observing the emitted infrared radiation with a focused detector or an infrared scanner. Although no experimental data using the photothermal technique has been obtained yet, a one-dimensional finite difference algorithm was used to model temperature changes on the surface of a chromium coating on steel due to an incident energy pulse. The model verifies that with a suitable choice of laser pulse width, one could measure the thermal characteristics of the coating and detect the presence of a thermal discontinuity at the interface. GRA

N93-24173# Army Materials Technology Lab., Watertown, MA.
ULTRASONIC INSPECTION OF FILAMENT WOUND GRAPHITE EPOXY CYLINDERS Final Report
Lisa A. Tardiff and Bradley M. Taher, III Sep. 1992 30 p
(AD-A260361; MTL-TR-92-61) Avail: CASI HC A03/MF A01

A nondestructive inspection procedure utilizing ultrasonic C-scan imaging was developed to test cylindrical filament wound graphite epoxy rocket motor cases. These cylinders are part of a joint U.S. Army, Navy, NASA, and Air force (JANNAF) research round robin to evaluate destructive testing techniques for this type of composite. The rocket motor cases are made from T650/42 graphite fibers (Amoco) in a Lincoln Resin Formulation (LRF) and have six layers (twelve plies). The ultrasonic method used to evaluate the rocket motor cases was immersion, pulse-echo defect C-scans. Difficulties and solutions of using this method to evaluate the rocket motor cases are discussed. The received ultrasonic signals were evaluated for reflections from discontinuities within the material by means of an electronic gate set between the front and back surface reflections. The signals were then imaged in color on a computer according to the amplitude of the reflections. The resultant color C-scans were evaluated to separate the good from the bad. In some rocket motor cases there appeared to be large delaminations and inclusions. There were also some that showed few or no defect indications. Ultrasonic attenuation and time-of-flight (velocity) scans were performed to evaluate their quality. Contact time-of-flight measurements were also taken on a number of cylinders to verify immersion results. Comparisons are made with transverse compression, transverse tension, and in-plane shear destructive test results. These comparisons verify the usefulness of electronically gated ultrasonic immersion, pulse echo, defect C-scans on filament wound cylinders. GRA

N93-24198 Minnesota Univ., Minneapolis.
MODELS AND ANALYSIS FOR MULTIVARIATE FAILURE TIME DATA
Ph.D. Thesis
Joanna Huang Shih 1992 186 p
Avail: Univ. Microfilms Order No. DA9234021

The goal of this research is to develop and investigate models and analytic methods for multivariate failure time data. We compare models in terms of direct modeling of the margins, flexibility of dependency structure, local vs. global measures of association, and ease of implementation. In particular, we study copula models, and models produced by right neutral cumulative hazard functions and right neutral hazard functions. We examine the changes of association over time for families of bivariate distributions induced from these models by displaying their density contour plots, conditional density plots, correlation curves of Doksum et al, and local cross ratios of Oakes. We know that bivariate distributions with same margins might exhibit quite different dependency structures. In addition to modeling, we study estimation procedures. For copula models, we investigate three estimation procedures. the first procedure is full maximum likelihood. The second procedure is two-stage maximum likelihood. At stage 1, we estimate the parameters in the margins by maximizing the marginal likelihood. At stage 2, we estimate the dependency structure by fixing the margins at the estimated ones. The third procedure is two-stage partially parametric maximum likelihood. It is similar to the second procedure, but we estimate the margins by the Kaplan-Meier estimate. We derive asymptotic properties for these three estimation procedures and compare their efficiency by Monte-Carlo simulations and direct computations. For models produced by right neutral cumulative hazards and right neutral hazards, we derive the likelihood and investigate the properties of the maximum likelihood estimates. Finally, we develop goodness of fit tests for the dependency structure in the copula models. We derive a test statistic and its asymptotic properties based on the test of homogeneity of Zelterman and Chen (1988), and a graphical diagnostic procedure based on the empirical Bayes approach. We study the performance of these two methods using actual and computer generated data. Dissert. Abstr.

N93-22170*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FAILURE ENVIRONMENT ANALYSIS TOOL APPLICATIONS
Ginger L. Pack and David B. Wadsworth (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 205-214 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N93-22412# Oak Ridge National Lab., TN.
EXPERIMENTAL INVESTIGATIONS OF THE FRACTURE TOUGHNESS ENHANCEMENT ASSOCIATED WITH SHALLOW FLAWS
T. J. Theiss, D. K. M. Shum, and S. T. Rolfe (Kansas Univ., Lawrence.) 1992 18 p Presented at the OECD/IAEA/CSNI Joint International Specialists Meeting on Fracture Mechanics Verification By Large Scale Testing, Knoxville, TN, 26-29 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-003100; CONF-9210209-2) Avail: CASI HC A03/MF A01

The Heavy Section Steel Technology Program (HSST) is investigating the influence of flaw depth on the fracture toughness of reactor pressure vessel (RPV) steel. Recently, it has been shown that shallow cracks tend to exhibit an elevated toughness as a result of a loss of constraint at the crack tip. The loss of constraint takes place when interaction occurs between the elastic-plastic crack-tip stress field and the specimen surface nearest the crack tip. An increased shadow-crack fracture toughness is of interest to the nuclear industry because probabilistic fracture-mechanics evaluations show that shallow flaws play a dominant role in the probability of vessel failure during postulated pressurized-thermal-shock (PTS) conditions. The HSST investigation is a joint analytical/experimental study combining the use of shallow-cracked laboratory specimens with RPV analysis. All tests were performed on beam specimens loaded in 3-point bending using specimens about 100 mm deep. Primarily two crack depths have been considered: a = 50 and 9 mm (a/W = 0.5 and 0.1). Test results indicate a significant increase in the fracture toughness associated with the shallow flaw specimens in the lower transition region compared to the conventional fracture toughness. The testing produced a limited database of fracture-toughness values as a function of crack depth which can be used in probabilistic or deterministic fracture mechanics analyses of pressure vessel integrity. Final test results from the shallow-crack fracture toughness program are included. Examination of previously tested thermal shock data reveals that no toughness elevation appears to be present even though the thermal shock cylinders were tested with shallow flaws. DOE

N93-22481*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.
COUPLED MULTI-DISCIPLINARY COMPOSITES BEHAVIOR SIMULATION
Surendra N. Singhal, Pappu L. N. Murthy (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), and Christos C. Chamis (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Feb. 1993 77 p Original contains color illustrations
(RTOP 505-63-53)
(NASA-TM-106011; E-7565; NAS 1.15:106011) Avail: CASI HC A05/MF A01; 3 functional color pages

The capabilities of the computer code CSTEM (Coupled Structural/Thermal/Electro-Magnetic Analysis) are discussed and demonstrated. CSTEM computationally simulates the coupled response of layered multi-material composite structures subjected to simultaneous thermal, structural, vibration, acoustic, and electromagnetic loads and includes the effect of aggressive environments. The composite material behavior and structural response is determined at its various inherent scales: constituents (fiber/matrix), ply, laminate, and structural component. The thermal and mechanical properties of the constituents are considered to be nonlinearly dependent on various parameters such as temperature and moisture. The acoustic and electromagnetic properties also include dependence on vibration and electromagnetic wave frequencies, respectively. The simulation is based on a three dimensional finite element analysis in conjunction with composite mechanics and with structural tailoring codes, and with acoustic and electromagnetic analysis methods. An aircraft engine composite fan blade is selected as a typical structural component to demonstrate the CSTEM capabilities. Results of various coupled multi-disciplinary heat transfer, structural, vibration, acoustic, and electromagnetic analyses for temperature distribution, stress and displacement response, deformed shape, vibration frequencies, mode shapes, acoustic noise, and electromagnetic reflection from the fan blade are discussed for their coupled effects in hot and humid environments. Collectively, these results demonstrate the effectiveness of the CSTEM code in capturing the coupled effects on the various responses of composite structures subjected to simultaneous multiple real-life loads. Author

N93-22500# Sandia National Labs., Albuquerque, NM.
PYROSHOCK SIMULATION FOR SATELLITE COMPONENTS USING A TUNABLE RESONANT FIXTURE
N. T. Davie and V. I. Bateman 1992 10 p Presented at the 14th Aerospace Testing Seminar, Manhattan Beach, CA, 9-11 Mar. 1993
(Contract DE-AC04-76DP-00789)
(DE93-005338; SAND-92-2135C; CONF-930391-1) Avail: CASI HC A02/MF A01

Aerospace components are often subjected to pyroshock events during flight and deployment, and must be qualified to this frequently severe environment. Laboratory simulation of pyroshock using a mechanically excited resonant fixture, has gained favor at Sandia for testing small (less than 8 inch cube) satellite and weapon components. With this method, each different shock environment required a different resonant fixture that was designed such that it's response reached the environment. A new test method has been developed which eliminates the need to have a different resonant fixture for each test requirement. This is accomplished by means of a tunable resonant fixture that has a response which is adjustable over a wide frequency range. The adjustment of the fixture's

response is done in a simple and deterministic way. This report covers the first phase of this research, which includes design conception through fabrication and evaluation of hardware capable of testing components with up to a 10 inch x 10 inch base. This method will ultimately allow the testing of much larger items, perhaps as large as entire small satellites.
DOE

N93-22516# Los Alamos National Lab., NM.
MICROPARTICLE IMPACTS AT ULTRAHIGH VELOCITIES AND THEIR RELATION TO MACROPARTICLE IMPACTS
J. M. Walsh, G. L. Stradling, G. C. Idzorek, B. P. Shafer, and H. L. Curling, Jr. 1992 12 p Presented at the Hypervelocity Impact Symposium, Austin, TX, 17-20 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003845; LA-UR-92-3810; CONF-921162-13) Avail: CASI HC A03/MF A01

The Hypervelocity Microparticle Impact project at Los Alamos has utilized electrostatically accelerated iron spheres of microscopic dimensions to generate ultra-high velocity impact experiments to about 100 km/S, an order of magnitude beyond data range for precisely controlled impact tests with ordinary macroscopic projectiles. Extreme smallness of the micro impact events brings into question whether usual shock-hydrodynamic size scaling can be assumed. Validity of size scaling (and its refinement) is questioned in the present study. Impact experiments are compared in which two impact events at a given velocity, a microscopic impact and a macroscopic impact, are essentially identical except that the projectile masses and crater volumes differ by nearly 12 orders of magnitude -- linear dimensions and times differing by 4 orders of magnitude. Strain rates at corresponding points in a deforming crater increase 4 orders of magnitude with the size reduction. Departures from exact scaling, by a factor of 3.7 in crater volume, are observed for copper targets -- with micro craters being smaller than scaling would predict. Measurement of impact craters for very small impact events leads to determination of metal yield stresses at strain rates more than two orders of magnitude greater than have been obtained by other methods. Determination of material strengths at these exceedingly high strain rates is important. Results are compared to recent theoretical models by Follansbee, Kochs and Rollett. The problem is addressed of predicting crater sizes in a target material with strain rate effects. Basic results are recalled on the late stage equivalence of hypervelocity impacts. For the strain rate dependent material to show that the curve of dimensionless crater volume versus impact velocity is replaced by a family of curves, each member of which is for one final crater size. The spacing of the curves is determined by the stress versus strain properties of the material.
DOE

N93-22518# Sandia National Labs., Albuquerque, NM.
A MODAL TEST OF A SPACE-TRUSS FOR STRUCTURAL PARAMETER IDENTIFICATION
T. G. Carne, R. L. Mayes, and M. B. Levine-West (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 1992 10 p Presented at the 11th International Modal Analysis Conference, Kissimmee, FL, 1-4 Feb. 1993
(Contract DE-AC04-76DP-00789)
(DE93-004043; SAND-92-2367C; CONF-930241-1) Avail: CASI HC A02/MF A01

The Jet Propulsion Laboratory is developing a large space-truss to support a micro-precision interferometer. A finite element model will be used to design and place passive and active elements in the truss to suppress vibration. To improve the model's predictive capability, it is desirable to identify uncertain structural parameters in the model by utilizing experimental modal data. Testing of both the components and the system was performed to obtain the data necessary to identify the structural parameters. Extracting a modal model, absent of bias errors, from measured data requires great care in test design and implementation. Testing procedures that are discussed include: verification of non-constraining shaker attachment, quantification of the non-linear structural response, and the design and effects of suspension systems used to simulate a free structure. In addition to these procedures, the accuracy of the measured frequency response functions are evaluated by comparing functions measured with random excitation, using various frequency resolutions, and with step sine excitation.
DOE

N93-22519# Sandia National Labs., Albuquerque, NM.
SYSTEM IDENTIFICATION OF THE JPL MICRO-PRECISION INTERFEROMETER TRUSS
J. R. Red-Horse, T. G. Carne, E. L. Marek, R. L. Mayes, G. W. Neat (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), and L. F. Sword (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 1992 16 p Presented at the 3rd International Conference on Adaptive Structures, San Diego, CA, 9-11 Nov. 1992
(Contract DE-AC04-76DP-00789)
(DE93-004044; SAND-92-2339C; CONF-9211135-1) Avail: CASI HC A03/MF A01

The JPL Micro-Precision Interferometer (MPI) is a testbed for studying the use of control-structure interaction technology in the design of space-based interferometers. A layered control architecture will be employed to regulate the interferometer optical system to tolerances in the nanometer range. An important aspect of designing and implementing the control schemes for such a system is the need for high fidelity, test-verified analytical structural models. This paper summarizes coordinated test and analysis efforts aimed at producing such a model for the MPI structure. Pretest analysis, modal testing and test-analysis reconciliation results are summarized for a series of tests at both the component and full system levels.
DOE

N93-22534# Sandia National Labs., Albuquerque, NM.
THEORIES OF ELASTOPLASTICITY COUPLED WITH CONTINUUM DAMAGE MECHANICS
N. R. Hansen Jan. 1993 197 p
(Contract DE-AC04-76DP-00789)
(DE93-007426; SAND-92-1436) Avail: CASI HC A09/MF A03

Inelastic material constitutive relations for elastoplasticity coupled with continuum damage mechanics are investigated. For elastoplasticity, continuum damage mechanics, and the coupled formulations, rigorous thermodynamic frameworks are derived. The elastoplasticity framework is shown to be sufficiently general to encompass J(sub 2) plasticity theories including general isotropic and kinematic hardening relations. The concepts of an intermediate undamaged configuration and a fictitious deformation gradient are used to develop a damage representation theory. An empirically-based, damage evolution theory is proposed to overcome some observed deficiencies. Damage deactivation, which is the negation of the effects of damage under certain loading conditions, is investigated. An improved deactivation algorithm is developed for both damaged elasticity and coupled elastoplasticity formulations. The applicability of coupled formulations is validated by comparing theoretical predictions to experimental data for a spectrum of materials and loads paths. The pressure-dependent brittle-to-ductile transitional behavior of concrete is replicated. The deactivation algorithm is validated using tensile and compression data for concrete. For a ductile material, the behavior of an aluminum alloy is simulated including the temperature-dependent ductile-to-brittle behavior features. The direct application of a coupled model to fatigue is introduced. In addition, the deactivation algorithm in conjunction with an assumed initial damage and strain is introduced as a novel method of simulating the densification phenomenon in cellular solids.
DOE

N93-22550# Maryland Univ., College Park. Inst. for Physical Science and Technology.
THE h, p AND h-p VERSION OF THE FINITE ELEMENT METHOD BASIC THEORY AND APPLICATIONS Technical Note
I. Babuska and B. Q. Guo May 1992 48 p
(Contract N00014-90-J-1030)
(AD-A260197; BN-1134) Avail: CASI HC A03/MF A01

The survey of the basic ideas and results of the h, p and h-p versions of the finite element method is presented in this paper. The topics covered include the following: finite element method, p-version of FEM, h-p version of FEM, and adaptive finite element method.
GRA

N93-22555*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.
IMPROVED TECHNIQUES FOR THERMOMECHANICAL TESTING IN SUPPORT OF DEFORMATION MODELING
Michael G. Castelli and John R. Ellis (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Cleveland, OH Nov. 1992 21 p

(RTOP 505-63-40)
(NASA-TM-105944; E-7568; NAS 1.15:105944) Avail: CASI HC A03/MF A01

The feasibility of generating precise thermomechanical deformation data to support constitutive model development was investigated. Here, the requirement is for experimental data that is free from anomalies caused by less than ideal equipment and procedures. A series of exploratory tests conducted on Hastelloy X showed that generally accepted techniques for strain controlled tests were lacking in at least three areas. Specifically, problems were encountered with specimen stability, thermal strain compensation, and temperature/mechanical strain phasing. The source of these difficulties was identified and improved thermomechanical testing techniques to correct them were developed. These goals were achieved by developing improved procedures for measuring and controlling thermal gradients and by designing a specimen specifically for thermomechanical testing. In addition, innovative control strategies were developed to correctly proportion and phase the thermal and mechanical components of strain. Subsequently, the improved techniques were used to generate deformation data for Hastelloy X over the temperature range, 200 to 1000 C. Author

N93-22680# Technische Univ., Berlin (Germany). Fachbereich Physikalische Ingenieurwissenschaft.
INCREMENTAL, QUASISTATIC, UNIAXIAL FINITE ELEMENT ANALYSIS IN THE LINEAR VISCOELASTICITY THEORY, EXEMPLARILY DEMONSTRATED BY THE BURGER MATERIAL Ph.D. Thesis [INKREMENTELLE, QUASISTATISCHE, EINACHSIGE FE-ANALYSE IN DER LINEAREN VISKOELASTIZITAERSTHEORIE AM BEISPIEL DES BURGER-MATERIALS]
Helmut Schmeitzner 1992 109 p In GERMAN
(ETN-93-93422) Avail: CASI HC A06/MF A02

The advantage of linear viscoelastic material description in the framework of finite element analysis is demonstrated. The material theoretical principles of linear viscoelastic material description are made available. The Burger material is presented, which incorporates all essential material properties of viscoelastic materials. A survey of computation processes is given for the quasistatic system analysis. A spatial column and a plane beam element are formulated, using the uniaxial, incremental Burger material law. Computation examples are presented. ESA

N93-22696# Ecole Centrale de Lyon (France).
TEMPORAL IDENTIFICATION OF LINEAR AND NONLINEAR STRUCTURES Ph.D. Thesis [IDENTIFICATION TEMPORELLE DES STRUCTURES LINEARIES ET NONLINEAIRES]
Bagus Budiwantoro 1990 186 p In FRENCH
(ECL-90-33; ETN-93-91948) Avail: CASI HC A09/MF A02

The identification of linear dynamic structures and the identification of nonlinear systems are addressed. The first problem is written under several representations in order to obtain the relations to extract the characteristic frequencies and the damping factors. A technique for choosing the number of degrees of freedom to be taken into account at system identification is developed and a method for normal mode calculation using a subdetermination of complex modes is used. For the second problem, the principal causes of nonlinearity and their influence on the dynamic behavior of the structural mechanics are analyzed. Numerical methods to solve linear equations are addressed, and various methods for identification of nonlinear models are presented. Results are applied to nonlinear systems with several degrees of freedom. ESA

N93-22704*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SCBUCKLE USER'S MANUAL: BUCKLING ANALYSIS PROGRAM FOR SIMPLE SUPPORTED AND CLAMPED PANELS
Juan R. Cruz Mar. 1993 27 p
(RTOP 505-63-50-08)
(NASA-TM-107741; NAS 1.15:107741) Avail: CASI HC A03/MF A01

The program SCBUCKLE calculates the buckling loads and mode shapes of cylindrically curved, rectangular panels. The panel is assumed to have no imperfections. SCBUCKLE is capable of analyzing specially orthotropic symmetric panels (i.e., A(sub 16) = A(sub 26) = 0.0, D(sub 16) = D(sub 26) = 0.0, B(sub ij) = 0.0). The analysis includes first-order transverse shear theory and is capable of modeling sandwich panels. The analysis supports two types of boundary conditions: either simply supported or clamped on all four edges. The panel can be subjected to linearly varying normal loads N(sub x) and N(sub y) in addition to a constant shear load N(sub xy). The applied loads can be divided into two parts: a preload component; and a variable (eigenvalue-dependent) component. The analysis is based on the modified Donnell's equations for shallow shells. The governing equations are solved by Galerkin's method. Author (revised)

N93-22708# Brookhaven National Lab., Upton, NY.
INVESTIGATION OF AZIMUTHAL STRESSES DUE TO WELDING AND COOLDOWN
M. Lindner and S. Mulhall 1992 3 p Presented at the 4th International Industrial Symposium on the Super Collider, New Orleans, LA, 4-6 Mar. 1992
(Contract DE-AC02-76CH-00016)
(DE93-005530; BNL-47862; CONF-920331-61) Avail: CASI HC A01/MF A01

For some time, it has been known that a prestress in the cold mass skin surrounding the yoke was desirable for the prevention of unwanted 'loose' coil effects on the performance of magnets. From practical experience, it was determined that the hoop stresses developed by seam welding were adequate to provide the desired preload on the coils. The tests reported here were intended to: (1) determine the stresses developed by welding; (2) attempt to determine the friction coefficient between the yoke laminations and the stainless steel shell; (3) determine the effects of repeated cooldown cycles on the stresses in the shell. DOE

N93-22721# Sandia National Labs., Albuquerque, NM.
EFFECT OF THE FLAP AND EDGEWISE BENDING MOMENT PHASE RELATIONSHIPS ON THE FATIGUE LOADS OF A TYPICAL HAWT BLADE
H. J. Sutherland 1992 7 p Presented at the 12th American Society Mechanical Engineers Wind Energy Symposium, Houston, TX, 31 Jan. - 4 Feb. 1993
(Contract DE-AC04-76DP-00789)
(DE93-003253; SAND-92-1665C; CONF-930153-1) Avail: CASI HC A02/MF A01

The load spectrum unposed upon a horizontal-axis wind turbine blade is typically decomposed into two primary bending moments; flap and edgewise bending. The critical fatigue loads (stress cycles) imposed on the blade may not be on one of these axes, especially if die two bending loads are in-phase with one another. To quantify the correlation of these two bending moments and determine the impact of this correlation on off-axis fatigue loads, an extensive data set for a typical wind turbine blade is examined. The results are compared using their respective cycle count matrices. These results illustrate that the harmonic components of die principal bending stresses are correlated, and that the random components are not. The analysis techniques described in the paper provide the turbine designer with a spectral technique for combining primary bending spectra into off-axis fatigue loads. DOE

N93-22751# Battelle Columbus Labs., OH.
A COMPUTATIONAL STUDY OF THE TIME DEPENDENT CRACK GROWTH PROCESS
F. W. Brust and P. Krishnaswamy 1992 8 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, Anaheim, CA, 8-13 Nov. 1992
(Contract DE-FG02-90ER-14135)
(DE93-004397; CONF-921110-42) Avail: CASI HC A02/MF A01

Universal studies of creep crack growth for constant load and variable load cases are presented. The results of the constant load cases are compared to experiment. The behavior of displacements and integral creep for fracture parameters are discussed for both load cases. The need for using a constitutive law which can handle cyclic creep is discussed. DOE

N93-22771# Technical Research Centre of Finland, Espoo. Metals Lab.
ANALYSIS OF AUTOMATED FATIGUE CRACK GROWTH RATE DATA
Gary Marquis 1992 30 p
(DE93-752853; VTT-PUB-108) Avail: CASI HC A03/MF A01

Automated crack length measuring methods have largely replaced manual techniques in many applications. They require little operator time and have the additional feature of being able to collect large amounts of data. A method for compressing a large number of crack length observations into

a smaller number of crack length estimates suitable for calculating the fatigue crack growth rate is described and verified using a simulation technique. With this method, the effective crack length measuring precision is improved and the amount of crack growth rate data obtainable from a single specimen is increased. Test times for threshold testing can also be potentially decreased. This method has been incorporated into a computer program, SAERMAE, currently in use in VTT Metals Laboratory. DOE

N93-22872# Los Alamos National Lab., NM.
MASSIVELY PARALLEL MOLECULAR DYNAMICS SIMULATIONS OF TWO-DIMENSIONAL MATERIALS AT HIGH STRAIN RATES
N. J. Wagner and B. L. Holian 1992 18 p Presented at the Material Research Society Symposium, Boston, MA, 2-6 Dec. 1992
(Contract W-7405-eng-36)
(DE93-003825; LA-UR-92-3737; CONF-921206-4) Avail: CASI HC A03/MF A01

Large scale molecular dynamics simulations on a massively parallel computer are performed to investigate the mechanical behavior of 2-dimensional materials. A pair potential and a model embedded atom many-body potential are examined, corresponding to 'brittle' and 'ductile' materials, respectively. A parallel molecular dynamics (MD) algorithm is developed to exploit the architecture of the Connection Machine, enabling simulations of greater than 10(exp 6) atoms. A model spallation experiment is performed on a 2-D triagonal crystal with a well-defined nanocrystalline defect on the spall plane. The process of spallation is modeled as a uniform adiabatic expansion. The spall strength is shown to be proportional to the logarithm of the applied strain rate and a dislocation dynamics model is used to explain the results. Good predictions for the onset of spallation in the computer experiments is found from the simple model. The nanocrystal defect affects the propagation of the shock front and failure is enhanced along the grain boundary. DOE

N93-22888# Carnegie-Mellon Univ., Pittsburgh, PA.
THE ROLE OF PASSIVE SURFACE FILMS ON CORROSION FATIGUE CRACK INITIATION
A. W. Thompson 1992 7 p
(Contract DE-FG02-84ER-45149)
(DE93-006512; DOE/ER-45149/3) Avail: CASI HC A02/MF A01

Fatigue testing on commercially pure titanium with low and high oxygen contents, chosen to produce quite different slip behaviors, wavy and planar, respectively, was carried out in air and in 1M H2SO4 solution, a strongly passivating environment for Ti. Goal was comparison of experimental fatigue data with a published model which rationalizes fatigue crack initiation under passive corrosion conditions. Although the general features of the experimental data were consistent with the tenets of the model, as was also the case in prior work using the stainless steel superalloy A-286, it appeared that the passivation conditions were so strong as to preclude the primary event proposed as the basis for the model, namely the emergence of slip steps through the passive film, thus permitting corrosive fatigue crack initiation. It is possible that choice of a less strong passivating environment would permit a better comparison of model and experiment for the CP Ti, an otherwise suitable experimental material. DOE

N93-22896# Oak Ridge National Lab., TN.
FRACTURE TOUGHNESS (K(SUB Ic) AND GAMMA wof) OF A HIPed Si3N4 AT ELEVATED TEMPERATURES
A. A. Wereszczak, M. K. Ferber, R. R. Sanders, M. G. Jenkins, and P. Khandelwal 1993 32 p Presented at the 17th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 11-15 Jan. 1993
(Contract DE-AC05-84OR-21400)
(DE93-006745; CONF-930164-6) Avail: CASI HC A03/MF A01

Chevron-notched bend bars of a hot isostatically pressed (HiPed) silicon nitride (PY6) were tested in three-point flexure in air at 25, 1000, 1200, 1300, and 1400 C. Stable crack growth was consistently produced at all the test temperatures. Average fracture toughness, K(sub Ic), and work of fracture, gamma(sub wof), decreased from 6.4 MPa(sm bullet)(radical)m and 52 J/sq m, respectively, at 25C to 4.5 MPa(sm bullet)(radical)m and 44 J/sq m at 1200 C; a 29 percent and 15 percent decrease in K(sub Ic) and gamma(sub wof). Tests conducted at 1300 C and 1400 C activated high temperature deformation mechanisms, which effectively caused greater specimen ductility and apparent greater fracture resistances. At 1400 C, K(sub Ic) and gamma(sub wof) were 6.5 MPa(sm bullet)(radical)m and 159 J/sq m, respectively. DOE

N93-22975# Sandia National Labs., Albuquerque, NM.
PYROSHOCK SIMULATION FOR SATELLITE COMPONENTS USING A TUNABLE RESONANT FIXTURE, PHASE 1
N. T. Davie and V. I. Bateman Oct. 1992 66 p
(Contract DE-AC04-76DP-00789)
(DE93-005382; SAND-92-2135) Avail: CASI HC A04/MF A01

Aerospace components are often subjected to pyroshock events during flight and deployment and must be qualified to this frequently severe environment. Laboratory simulation of pyroshock using a mechanically excited resonant fixture, has gained favor at Sandia for testing small (less than 8 inch cube) weapon components. With this method, each different shock environment required a different resonant fixture that was designed such that it's response matched the environment. A new test method was developed which eliminates the need to have a different resonant fixture for each test requirement. This is accomplished by means of a tunable resonant fixture that has a response which is adjustable over a wide frequency range. The adjustment of the fixture's response is done in a simple and deterministic way. This report covers the first phase of this research, which includes design conception through fabrication and evaluation of hardware capable of testing components with up to a 10 inch x 10 inch base. This method will ultimately allow the testing of much larger items, perhaps as large as entire small satellites. DOE

N93-23012*# Alabama Univ., Huntsville. Dept. of Civil and Environmental Engineering.
REPEATABILITY AND UNCERTAINTY ANALYSES OF NASA/MSFC LIGHT GAS GUN TEST DATA Final Report, 23 Feb. 1990 - 22 Dec. 1992
William P. Schonberg and David Cooper Mar. 1993 130 p
(Contract NAS8-36955)
(NASA-CR-192496; NAS 1.26:192496) Avail: CASI HC A07/MF A02

This Final Report presents an overview of the impact tests performed at NASA/MSFC in the time period 1985 to 1991 and the results of phenomena repeatability and data uncertainty studies performed using the information obtained from those tests. An analysis of the data from over 400 tests conducted between 1989 and 1991 was performed to generate a database to supplement the Hypervelocity Impact Damage Database developed under a previous effort. Author

N93-23015*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STRUCTURAL ANALYSIS OF HIGH-RPM COMPOSITE PROPFAN BLADES FOR A CRUISE MISSILE WIND TUNNEL MODEL
David A. Carek Mar. 1993 22 p Original contains color illustrations
(RTOP 535-03-0B)
(NASA-TM-105267; E-7340; NAS 1.15:105267) Avail: CASI HC A03/MF A01; 1 functional color page

Analyses were performed on a high-speed composite blade set for the Department of Defense Propfan Missile Interactions Project. The final design iteration, which resulted in the CM2D-2 blade design, is described in this report. Mode shapes, integral order excitation, and stress margins were examined. In addition, geometric corrections were performed to compensate for blade deflection under operating conditions with respect to the aerodynamic design shape. Author

N93-23044*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPLEMENTATION OF THE BLOCK-KRYLOV BOUNDARY FLEXIBILITY METHOD OF COMPONENT SYNTHESIS
Kelly S. Carney, Ayman A. Abdallah (Analex Corp., Brook Park, OH.), and Arthur A. Hucklebridge (Case Western Reserve Univ., Cleveland, OH.) May 1993 22 p Proposed for presentation at the 1993 MSC World User's Conference, Washington, DC, 24-28 May 1993; sponsored by the MacNeal-Schwendler Corp.
(NASA-TM-106065; E-7671; NAS 1.15:106065) Avail: CASI HC A03/MF A01

A method of dynamic substructuring is presented which utilizes a set of static Ritz vectors as a replacement for normal eigenvectors in component mode synthesis. This set of Ritz vectors is generated in a recurrence

relationship, which has the form of a block-Krylov subspace. The initial seed to the recurrence algorithm is based on the boundary flexibility vectors of the component. This algorithm is not load-dependent, is applicable to both fixed and free-interface boundary components, and results in a general component model appropriate for any type of dynamic analysis. This methodology was implemented in the MSC/NASTRAN normal modes solution sequence using DMAP. The accuracy is found to be comparable to that of component synthesis based upon normal modes. The block-Krylov recurrence algorithm is a series of static solutions and so requires significantly less computation than solving the normal eigenspace problem.

Author (revised)

N93-23050# Westinghouse Savannah River Co., Aiken, SC.

J-INTEGRAL OF CIRCUMFERENTIAL CRACK IN LARGE DIAMETER PIPES

Wei Ji (South Carolina Univ., Columbia.), Yuh J. Chao (South Carolina Univ., Columbia.), M. A. Sutton (South Carolina Univ., Columbia.), P. S. Lam, and G. E. Mertz 1992 11 p Presented at the 2nd International Conference on Nuclear Engineering, San Francisco, CA, 21-24 Mar. 1992

(Contract DE-AC09-89SR-18035)

(DE93-003708; WSRC-MS-92-320; CONF-9203208-1) Avail: CASI HC A03/MF A01

Large diameter thin-walled pipes are encountered in a low pressure nuclear power piping system. Fracture parameters such as K and J, associated with postulated cracks, are needed to assess the safety of the structure, for example, prediction of the onset of tile crack growth and the stability of the crack. The Electric Power Research Institute (EPRI) has completed a comprehensive study of cracks in pipes and handbook-type data is available. However, for some large diameter, thin-walled pipes the needed information is not included in the handbook. This paper reports our study of circumferential cracks in large diameter, thin-walled pipes (R/t=30 to 40) under remote bending or tension loads. Elastic-Plastic analyses using the finite element method were performed to determine the elastic and fully plastic J values for various pipe/crack geometries. A non-linear Ramberg-Osgood material model is used with strain hardening exponents (n) that range from 3 to 10. A number of circumferential, through thickness cracks were studied with half crack angles ranging from 0.063(pi) to 0.5(pi). Results are tabulated for use with the EPRI estimation scheme.

DOE

N93-23053*# Northwestern Univ., Evanston, IL. Dept. of Mechanical Engineering.

PROBABILISTIC FINITE ELEMENTS FOR FATIGUE AND FRACTURE ANALYSIS Final Report

Ted Belytschko and Wing Kam Liu Apr. 1993 61 p

(Grant NAG3-822; RTOP 584-03-11)

(NASA-CR-191098; E-7711; NAS 1.26:191098) Avail: CASI HC A04/MF A01

An overview of the probabilistic finite element method (PFEM) developed by the authors and their colleagues in recent years is presented. The primary focus is placed on the development of PFEM for both structural mechanics problems and fracture mechanics problems. The perturbation techniques are used as major tools for the analytical derivation. The following topics are covered: (1) representation and discretization of random fields; (2) development of PFEM for the general linear transient problem and nonlinear elasticity using Hu-Washizu variational principle; (3) computational aspects; (4) discussions of the application of PFEM to the reliability analysis of both brittle fracture and fatigue; and (5) a stochastic computational tool based on stochastic boundary element (SBEM). Results are obtained for the reliability index and corresponding probability of failure for: (1) fatigue crack growth; (2) defect geometry; (3) fatigue parameters; and (4) applied loads. These results show that initial defect is a critical parameter.

Author (revised)

N93-23056*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.

HIGH TEMPERATURE COMPOSITE ANALYZER (HITCAN) PROGRAMMER'S MANUAL. VERSION 1.0

J. J. Lackney, P. L. N. Murthy (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.), and P. K. Gotsis (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Apr. 1993 133 p

(Grant NAG3-25266; RTOP 505-63-5B)

(NASA-TM-106004; E-7547; NAS 1.15:106004) Avail: CASI HC A07/MF A02

This manual describes the organization and flow of data and analysis modules in the computer code, HITCAN (High Temperature Composite ANalyzer). HITCAN is a general purpose computer program for predicting nonlinear global structural and local stress-strain response of arbitrarily oriented, multilayered high temperature metal matrix composite structures. This manual describes the architecture of the HITCAN code, followed by the listing of subroutines and calling tree, data storage scheme, file system, and a dictionary of code terminology. The primary intention of the manual is to familiarize the user with some of the computer program related issues so as to facilitate maintenance/modification/updates of the HITCAN computer code.

Author

N93-23072 Case Western Reserve Univ., Cleveland, OH.

X RAY ABSORPTION FINE STRUCTURE STRAIN DETERMINATION IN THIN FILMS Ph.D. Thesis

Guy Arthur DeRose 1992 204 p

Avail: Univ. Microfilms Order No. DA9236314

X-ray Absorption Fine Structure (XAFS) spectroscopy was examined, for the first time, as a technique for the determination of elastic strain in thin evaporated films and thin foils. The electron yield and fluorescence yield detection techniques were used to collect the XAFS data. For sensitivity reasons, back-reflection X-Ray Diffraction (XRD) was also carried out. Continuum mechanics was used to model the deformation of the first shell and was compared to experimental observations. A local, non-linear elastic strain was observed by XAFS and is the same quantity measured by XRD. In general, the measured magnitude of the XAFS strain was found to be less than the model predicts, and relaxation of the stress in the substrate or the foil is suggested as the responsible mechanism. Dissert. Abstr.

N93-23104*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PRELIMINARY ANALYSIS TECHNIQUES FOR RING AND STRINGER STIFFENED CYLINDRICAL SHELLS

J. Graham Mar. 1993 104 p

(NASA-TM-108399; NAS 1.15:108399) Avail: CASI HC A06/MF A02

This report outlines methods of analysis for the buckling of thin-walled circumferentially and longitudinally stiffened cylindrical shells. Methods of analysis for the various failure modes are presented in one cohesive package. Where applicable, more than one method of analysis for a failure mode is presented along with standard practices. The results of this report are primarily intended for use in launch vehicle design in the elastic range. A Microsoft Excel worksheet with accompanying macros has been developed to automate the analysis procedures.

Author

N93-23120# Technical Research Centre of Finland, Espoo. Metals Lab.

FINITE-ELEMENT PRE-ANALYSES FOR PRESSURIZED THERMOSHOCK TESTS. VESSEL 1: TESTS 4, 5, AND 6

Heikki Keinaenen, Heli Talja, Mikko Lehtonen, Rauno Rintamaa, Ralf Ahlstrand (Imatran Voima Oy, Helsinki, Finland.), Pekka Nurkkala (Imatran Voima Oy, Helsinki, Finland.), Pentti Rajamaeki (Imatran Voima Oy, Helsinki, Finland.), Alexander Bljumin (Central Research Inst. of Structural Materials, Finland.), and Boris Timofeev (Central Research Inst. of Structural Materials, Finland.) 1992 37 p Sponsored by Minisitry of Trade and Industry; Finnish Centre for Radiation and Nuclear Safety; and Imatran Voima Oy Original contains color illustrations

(VTT-Pubs-103; ISBN-951-38-4221-5; ETN-93-93542) Copyright Avail: CASI HC A03/MF A01

The behavior of a model pressure vessel on a pressurized thermal shock loading is studied. The finite element analyses for the 4th, 5th, and 6th thermoshock tests with the first model pressure vessel are described. In the 4th and 5th tests, a sharp precrack was produced before the test. In the 6th test, the old crack was used. According to the measurements and a post test ultrasonic examination of the crack front, the sixth test led to significant crack extension. Both temperatures and stresses were calculated using the finite element method. The calculations were made using the idealized initial flaw geometry and preliminary material data. Both two and three dimensional models were used in the calculations. J integral values were calculated from the elastic plastic finite element results. The stress intensity factor values were evaluated on the basis of the calculated

J integrals and compared with the preliminary material fracture toughness data obtained. When the calculated temperatures, strains and crack opening displacements are compared to measured values, a sufficient agreement is observed. The calculated stress intensity factor exceeds the preliminary material fracture toughness value and thus crack initiation is predicted.
ESA

N93-23125*# Sverdrup Technology, Inc., Brook Park, OH. Lewis Research Center Group.
ASSESSMENT OF CRACK GROWTH IN A SPACE SHUTTLE MAIN ENGINE FIRST-STAGE, HIGH-PRESSURE FUEL TURBOPUMP BLADE
Ali Abdul-Aziz Mar. 1993 19 p Original contains color illustrations
(Contract NAS3-25266; RTOP 553-13-00)
(NASA-CR-190782; E-7396; NAS 1.26:190782) Avail: CASI HC A03/MF A01; 4 functional color pages

A two-dimensional finite element fracture mechanics analysis of a space shuttle main engine (SSME) turbine blade firtree was performed using the MARC finite element code. The analysis was conducted under combined effects of thermal and mechanical loads at steady-state conditions. Data from a typical engine stand cycle of the SSME were used to run a heat transfer analysis and, subsequently, a thermal structural fracture mechanics analysis. Temperature and stress contours for the firtree under these operating conditions were generated. High stresses were found at the firtree lobes where crack initiation was triggered. A life assessment of the firtree was done by assuming an initial and a final crack size. Author

N93-23182 Utah Univ., Salt Lake City.
AN INVESTIGATION INTO THE MULTIAXIAL FATIGUE BEHAVIOR OF IMI 829 TITANIUM ALLOY Ph.D. Thesis
Daniel Edward Gerbec 1992 149 p
Avail: Univ. Microfilms Order No. DA9236269

This document studies the effect that multiaxial stress fields have on the fatigue behavior of IMI 829 titanium alloy, a material often used for compressor disks in gas turbine engines. Experimentation in this study has included the cyclic testing of rotating disk specimens of varying geometries as well as ASTM E-647 crack growth testing employing standard compact tension specimens. Fractographic and microstructural examinations were also conducted. It was observed that the disk specimens demonstrated lower crack growth rates for a given stress intensity range than did the compact tension specimens. This behavior was explained by considering the effect of the multiaxial stress field on the crack tip opening displacement. Any loads parallel to a given crack will effectively reduce the crack tip opening displacement due to the Poisson effect, resulting in a smaller crack tip plastic zone which has been previously related to crack growth rate. Fractographic examination of the disk and compact tension specimens indicated that the disk specimens were much more likely to form striations than did the compact tension specimens. This was explained by the fact that the test conditions differed between the disk and compact tension specimens. Due to mechanical limitations, the cyclic frequency of the disk specimens was considerably lower than the cyclic frequency of the compact tension tests. Differences in test temperature may also have influenced the change in fracture surface between the specimens. The effect that microstructure had on the fatigue crack growth in the disk specimens was investigated as well. It was observed that crack generally followed a transgranular path. It was also noted that when possible, the crack would attempt to cross prior beta grain boundaries at right angles. The existence of grain boundary aligned alpha was found to influence this behavior.
Dissert. Abstr.

N93-23199 Toledo Univ., OH.
DYNAMIC RESPONSE AND STABILITY OF SEMI-RIGID FRAMES Ph.D. Thesis
Omar Ali Abu-Yasein 1992 233 p
Avail: Univ. Microfilms Order No. DA9235766

This dissertation presents a method to determine the load capacity as well as end member forces and deformations of frames with partial rigid joint connections by using the direct stiffness method. The connections are modeled as rotational springs attached at the ends of framed members. The lumped mass method, which is an approximate method, and the distributed mass method, which is an exact method, are also presented to compute the natural frequency of frames. The effects of the axial forces and the flexibility of joint connections are both included. Furthermore, the time-dependent response of semi-rigid frames subjected to periodic axial forces is formulated. The harmonic function is approximated by dividing the periodic function into n intervals and the periodic axial forces are evaluated at each time interval as constant forces using 'piecewise approximation'. The regions of instability of frames with different joint stiffness were determined using the characteristic equation method. The time-dependent part of the differential equation for free vibration of a framed member subjected to a harmonic force can be written in the form of the Mathieu-Hill equation where all characteristics of the Mathieu-Hill equation solutions can be used to determine the boundaries of instability regions.
Dissert. Abstr.

N93-23200 Michigan State Univ., East Lansing.
APPLICATION OF THE BOUNDARY ELEMENT METHOD TO FINITE ELASTICITY Ph.D. Thesis
Husain Jubran Algahtani 1992 104 p
Avail: Univ. Microfilms Order No. DA9233853

A boundary element method solution for the problem of finite plane deformation of elastic compressible and incompressible solids is presented. Two types of constitutive relation are considered: the Blatz-Ko model for compressible materials and the Mooney-Rivlin model for incompressible materials. The finite elasticity solution is obtained by solving the nonlinear boundary element equations using an iterative procedure. The iterative procedure is implemented in two computer codes which can be used to solve the problem of plane finite elasticity of Blatz-Ko and Mooney-Rivlin materials, respectively. The computer codes were tested using several numerical examples.
Dissert. Abstr.

N93-23235*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CORRELATION OF GROUND TESTS AND ANALYSES OF A DYNAMICALLY SCALED SPACE STATION MODEL CONFIGURATION
Mehzad Javeed (Lockheed Engineering and Sciences Co., Hampton, VA.), Harold H. Edighoffer (Analytical Services and Materials, Inc., Hampton, VA.), and Paul E. McGowan Mar. 1993 14 p Proposed for presentation at the 34th Structures, Structural Dynamics, and Materials Conference, La Jolla, CA, 19-21 Apr. 1993
(RTOP 585-03-11-09)
(NASA-TM-107729; NAS 1.15:107729) Avail: CASI HC A03/MF A01

Verification of analytical models through correlation with ground test results of a complex space truss structure is demonstrated. A multi-component, dynamically scaled space station model configuration is the focus structure for this work. Previously established test/analysis correlation procedures are used to develop improved component analytical models. Integrated system analytical models, consisting of updated component analytical models, are compared with modal test results to establish the accuracy of system-level dynamic predictions. Design sensitivity model updating methods are shown to be effective for providing improved component analytical models. Also, the effects of component model accuracy and interface modeling fidelity on the accuracy of integrated model predictions is examined. Author

N93-23291# Los Alamos National Lab., NM.
ULTRA-HIGH VELOCITY IMPACTS: CRATERING STUDIES OF MICROSCOPIC IMPACTS FROM 3 km/s TO 30 km/s
G. L. Stradling, G. C. Idzorek, B. P. Shafer, H. L. Curling, Jr. (Science Applications International Corp., Albuquerque, NM.), M. T. Collopy (Science Applications International Corp., Albuquerque, NM.), and A. A. HopkinsBlossom (EG and G Energy Measurements, Inc., Los Alamos, NM.) 1992 12 p Presented at the Hypervelocity Impact Symposium, Austin, TX, 17-20 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003846; LA-UR-92-3811; CONF-921162-12) Avail: CASI HC A03/MF A01

Cratering experiments performed under carefully controlled conditions at impact velocities ranging from 3 km/s to 30 km/s into a wide variety of target materials are presented. These impact experiments use the 6 MV vertical Van de Graaff accelerator of the Ion Beam Facility at the Los Alamos National Laboratory to electrostatically accelerate highly charged iron microspheres. The sub-micron spheres, from a random size distribution, are shocklessly accelerated along an 8 m flight path. Ultra-sensitive charge detectors monitor the passage of the projectiles at a rate of up to 100

projectiles/second. An online computer records and displays in real time the charge, velocity and mass of the projectiles and provides cross correlation between the events observed by the several in-flight charge detectors and impact detectors. Real-time logic controls an electrostatic kicker which deflects projectiles of selected charge and velocity onto the target. Thus each experiment consists of an ensemble of 10 to 40 impacts onto a single target within a narrow window of the projectile parameter space, providing excellent statistical resolution of each data point. The target materials used include single crystal copper and single crystal aluminum, gold, and quartz as well as pyrolytic graphic and epoxy used in composite materials of interest to space applications. We also conducted impact experiments onto thin Mylar and nickel foils. This paper presents these experiments and summarizes the cratering characterization performed to date. Emphasis is placed on cratering results in several materials over a range of impact velocities. DOE

N93-23317# Battelle Memorial Inst., Columbus, OH.
CONSIDERATION OF HISTORY DEPENDENT DAMAGE IN CREEP CRACK GROWTH
F. W. Brust, Jr., P. Krishnaswamy, and B. S. Majumdar 1992 9 p Presented at the 10th Symposium on Energy Engineering Sciences: Synergism of Analysis, Modeling, and Experiment, Argonne, IL, 11-13 May 1992
(Contract DE-FG02-90ER-14135)
(DE93-004398; CONF-9205147-4) Avail: CASI HC A02/MF A01

The effects of load history on the creep crack growth process are discussed. There are three aspects of this problem which are considered: (1) the constitutive response of materials undergoing history dependent creep straining, (2) the corresponding crack growth behavior including a discussion of fracture parameters capable of predicting the response, and (3) experimental evidence of the importance of history dependent response. Finally, numerical studies which use the constitutive model and fracture theory of (1) and (2) respectively are used to examine the experimental results developed in (3). DOE

N93-23380 Virginia Polytechnic Inst. and State Univ., Blacksburg.
MOIRE INTERFEROMETRY AT HIGH TEMPERATURES Ph.D. Thesis
Jau-Je Wu 1992 132 p
Avail: Microfilms Order No. DA9301022

The objective of this study was to provide an optical technique allowing full-field in-plane deformation measurements at high temperature by using high-sensitivity moire interferometry. This was achieved by a new approach of performing deformation measurements at high temperatures in a vacuum oven using an achromatic interferometer. The moire system setup was designed with particular consideration for the stability, compactness, flexibility, and ease of control. A vacuum testing environment was provided to minimize the instability of the patterns by protecting the optical instruments from the thermal convection currents. Also, a preparation procedure for the high-temperature specimen grating was developed with the use of the plasma-etched technique. Gold was used as a metallic layer in this procedure. This method was demonstrated on a ceramic block, metal/matrix composite, and quartz. Thermal deformation of a quartz specimen was successfully measured in vacuum at 980 degrees Celsius, with the sensitivity of 417 nm per fringe. The stable and well-defined interference patterns confirmed the feasibility of the developments, including the high-temperature moire system and high-temperature specimen grating. The moire system was demonstrated to be vibration-insensitive. Also, the contrast of interference fringes at high temperature was enhanced by means of a spatial filter and a narrow band interference filter to minimize the background noise from the flow of the specimen and heater. The system was verified by a free thermal expansion test of an aluminum block. Good agreement demonstrated the validity of the optical design. The measurements of thermal deformation mismatch were performed on a graphite/epoxy composite, a metal/matrix composite equipped with an optical fiber, and a cutting tool bit. A high-resolution data-reduction technique was used to measure the strain distribution of the cutting tool bit. Dissert. Abstr.

N93-23406*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FATIGUE CRITERION TO SYSTEM DESIGN, LIFE AND RELIABILITY: A PRIMER
Erwin V. Zaretsky Oct. 1992 18 p Workshop on Computational Methods for Failure Analysis and Life Prediction held in Hampton, VA, 14-15 Oct. 1992
(RTOP 505-63-5B)
(NASA-TM-106022; E-7736; NAS 1.15:106022) Avail: CASI HC A03/MF A01

A method for estimating a component's design survivability by incorporating finite element analysis and probabilistic material properties was developed. The method evaluates design parameters through direct comparisons of component survivability expressed in terms of Weibull parameters. The analysis was applied to a rotating disk with mounting bolt holes. The highest probability of failure occurred at, or near, the maximum shear stress region of the bolt holes. Distribution of material failure as a function of Weibull slope affects the probability of survival. Where Weibull parameters are unknown for a rotating disk, it may be permissible to assume Weibull parameters, as well as the stress-life exponent, in order to determine the qualitative effect of disk speed on the probability of survival. Author

N93-23411*# Sverdrup Technology, Inc., Brook Park, OH. Lewis Research Center Group.
HIGH TEMPERATURE COMPOSITE ANALYZER (HITCAN) DEMONSTRATION MANUAL, VERSION 1.0
S. N Singhal, J. J. Lackney, and P. L. N. Murthy (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Apr. 1993 140 p
(Contract NAS3-25266; RTOP 505-63-5B)
(NASA-TM-106003; E-7546; NAS 1.15:106003) Avail: CASI HC A07/MF A02

This manual comprises a variety of demonstration cases for the HITCAN (HIgh Temperature Composite ANalyzer) code. HITCAN is a general purpose computer program for predicting nonlinear global structural and local stress-strain response of arbitrarily oriented, multilayered high temperature metal matrix composite structures. HITCAN is written in FORTRAN 77 computer language and has been configured and executed on the NASA Lewis Research Center CRAY XMP and YMP computers. Detailed description of all program variables and terms used in this manual may be found in the User's Manual. The demonstration includes various cases to illustrate the features and analysis capabilities of the HITCAN computer code. These cases include: (1) static analysis, (2) nonlinear quasi-static (incremental) analysis, (3) modal analysis, (4) buckling analysis, (5) fiber degradation effects, (6) fabrication-induced stresses for a variety of structures; namely, beam, plate, ring, shell, and built-up structures. A brief discussion of each demonstration case with the associated input data file is provided. Sample results taken from the actual computer output are also included. Author

N93-23484# Ohio State Univ., Columbus. Research Foundation.
VIBRATION CONTROL EXPERIMENTS ON A 12-METER CANTILEVER TRUSS STRUCTURE Final Report, Nov. 1987 - Nov. 1991
Uemit Oezguener, Stephen Yurkovich, Peter Dix, Layne Lenning, and Anne Bruner Aug. 1992 116 p
(Contract F33615-87-C-3257)
(AD-A259764; OSURF-766464; OSURF-720289; WL-TR-92-3024) Avail: CASI HC A06/MF A02

Control objectives for large flexible space structures such as reorientation maneuvers, vibration suppression, fine pointing, and precision shape control require reliable and robust control algorithms. The modal characteristics of such structures including large order, low frequency with low damping, and closely spaced modes of vibration demand complexities in the control design which go beyond traditional methodologies and present difficult challenges. The Large Space Structures Technology Program at the Flight Dynamics Directorate of the Wright Laboratory was begun as an in-house experimental research program in the dynamics and control of flexible space structures. The 12-Meter Truss Active Control Experiment has been conducted as part of the Large Space Structures Technology Program to address modeling and active vibration damping issues on a representative laboratory-scale model of future large flexible space structures. Our objectives, as part of the 12-Meter Truss Active Control Experiment, have been to identify several controller design techniques for active vibration damping, to examine these techniques via simulation studies, and to implement a number of the designs on the 12-meter truss. This report describes experiment, modeling, and the design and testing of several control approaches on the 12-meter truss. GRA

N93-23590 South Carolina Univ., Columbia.
MEASUREMENT OF THREE-DIMENSIONAL CRACK TIP DEFORMATION BY DIGITAL IMAGE PROCESSING Ph.D. Thesis
Perng-Fei Luo 1992 209 p
Avail: Univ. Microfilms Order No. DA9239062

Based on a pinhole camera model, camera model equations, which account for the radial lens distortion, are used to map three-dimensional (3D) world coordinates to two-dimensional (2D) computer image coordinates by the use of camera intrinsic and extrinsic parameters. Using two cameras to form a stereo vision and applying 2D digital image correlation techniques, the 3D information can be obtained. To achieve this, a camera calibration technique was developed to obtain the optimal intrinsic and extrinsic camera parameters for each camera. Such stereo imaging system was used to measure both in-plane and out-of-plane displacement fields around the crack tip of fracture specimens made of Aluminum 6061-T6 and 304L stainless steel. To compare with the available two-dimensional theory of fracture mechanics, the measured displacement fields expressed in the world coordinate were converted, through coordinate transformations, to the displacement fields expressed in the specimen crack tip coordinates. By using a smoothing technique, the in-plane displacement components were smoothed and the total strains were obtained. To better understand the trend of the displacement field, rigid body motion was eliminated from the smooth in-plane displacement components and unsmoothed out-of-plane displacements. Results were compared with theoretical elastic and elastic-plastic fields. A K(sub I) field was detected for the Al specimen, but no HRR field was found. For 304L, a K(sub I) field was observed at lower loadings and an apparent HRR field was obtained at larger loadings. The two-dimensional J integral calculated using the experimentally determined in-plane displacements is path independent for each material. The J integral values for the aluminum specimen are close to the results obtained from both Merkle-Corten's formula and the EPRI report, but are 30 to 50 percent lower than the results obtained from the EPRI report for the stainless steel specimen. Dissert. Abstr.

N93-23689# Argonne National Lab., IL.
CHAOTIC VIBRATIONS OF TUBES WITH NONLINEAR SUPPORTS IN CROSSFLOW
Y. Cai and S. S. Chen 1992 31 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA, 8-13 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-004247; ANL/CP-75489; CONF-921110-43) Avail: CASI HC A03/MF A01

By means of the unsteady flow theory and a bilinear mathematical model, a theoretical study is presented for chaotic vibrations associated with the fluid-elastic instability of nonlinearly supported tubes in a crossflow. A series of effective tools, including phase portraits, power spectral density, Poincare maps, Lyapunov exponent, fractal dimension, and bifurcation diagrams, are utilized to distinguish periodic and chaotic motions when the tubes vibrate in the instability region. Results show periodic and chaotic motions in the region corresponding to the fluid damping controlled instability. Nonlinear supports, with symmetric or asymmetric gaps, significantly affect the distributions of periodic, quasiperiodic and chaotic motions of the tube with various flow velocity in the instability region of the TSP (tube-support-plate) inactive mode. DOE

N93-23700# Texas Univ., El Paso.
DAMAGE EVALUATION OF STRUCTURES USING FREQUENCIES AND MODE SHAPES EXTRACTED FROM LASER INTERFEROMETRY Final Report, Sep. 1989 - Aug. 1992
Roberto A. Osegueda Nov. 1992 12 p
(Contract DAAL03-89-G-0104)
(AD-A260119; ARO-27260.9-EG-SAH) Avail: CASI HC A03/MF A01

Nondestructive damage evaluation theories to detect, locate and quantify damage in structures from vibrational characteristic measurements are summarized. Modal analysis experiments were conducted on cantilever beams and suspended plates using a laser interferometer vibration pattern imager. Resonant frequencies and mode shapes measured before and after damage were used to assess the inflicted damage. Three theories of damage detection were tested with the experimental measurements. It was found that the exact eigenvalue sensitivity method, which relates changes in eigenvalues and mode shapes to damage parameters, worked well in detecting the damage after an analytical model of the undamaged system was identified. However, the method was very sensitive to errors in the mode shape measurements. A method based on sensitivity of damage to eigenvectors required measurements of small changes of eigenvectors and was not proven. A modal strain energy approach, which culminated in an expression relating changes in thickness to changes in modal curvatures, is also summarized. Modal curvatures were obtained through curve-fitting and smoothing techniques. This method worked very well for cantilever beams but fail to conclusively detect damage in plates. GRA

N93-23735*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
surf3d: A 3-D FINITE-ELEMENT PROGRAM FOR THE ANALYSIS OF SURFACE AND CORNER CRACKS IN SOLIDS SUBJECTED TO MODE-1 LOADINGS
I. S. Raju (Analytical Services and Materials, Inc., Hampton, VA.) and J. C. Newman, Jr. Feb. 1993 101 p
(RTOP 505-63-50-04)
(NASA-TM-107710; NAS 1.15:107710) Avail: CASI HC A06/MF A02

A computer program, surf3d, that uses the 3D finite-element method to calculate the stress-intensity factors for surface, corner, and embedded cracks in finite-thickness plates with and without circular holes, was developed. The cracks are assumed to be either elliptic or part eliptic in shape. The computer program uses eight-noded hexahedral elements to model the solid. The program uses a skyline storage and solver. The stress-intensity factors are evaluated using the force method, the crack-opening displacement method, and the 3-D virtual crack closure methods. In the manual the input to and the output of the surf3d program are described. This manual also demonstrates the use of the program and describes the calculation of the stress-intensity factors. Several examples with sample data files are included with the manual. To facilitate modeling of the user's crack configuration and loading, a companion program (a preprocessor program) that generates the data for the surf3d called gensurf was also developed. The gensurf program is a three dimensional mesh generator program that requires minimal input and that builds a complete data file for surf3d. The program surf3d is operational on Unix machines such as CRAY Y-MP, CRAY-2, and Convex C-220. Author

N93-23739*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SOLVING MODAL EQUATIONS OF MOTION WITH INITIAL CONDITIONS USING MSC/NASTRAN DMAP. PART 1: IMPLEMENTING EXACT MODE SUPERPOSITION
Ayman A. Abdallah (Analex Corp., Brook Park, OH.), Alan R. Barnett (Analex Corp., Brook Park, OH.), Omar M. Ibrahim (Analex Corp., Brook Park, OH.), and Richard T. Manella May 1993 14 p Presented at the 1993 MSC/NASTRAN World Users' Conference, Arlington, VA, May 1993; sponsored by the MacNeal-Schwendler Corp.
(NASA-TM-106063; E-7669; NAS 1.15:106063) Avail: CASI HC A03/MF A01

Within the MSC/NASTRAN DMAP (Direct Matrix Abstraction Program) module TRD1, solving physical (coupled) or modal (uncoupled) transient equations of motion is performed using the Newmark-Beta or mode superposition algorithms, respectively. For equations of motion with initial conditions, only the Newmark-Beta integration routine has been available in MSC/NASTRAN solution sequences for solving physical systems and in custom DMAP sequences or alters for solving modal systems. In some cases, one difficulty with using the Newmark-Beta method is that the process of selecting suitable integration time steps for obtaining acceptable results is lengthy. In addition, when very small step sizes are required, a large amount of time can be spent integrating the equations of motion. For certain aerospace applications, a significant time savings can be realized when the equations of motion are solved using an exact integration routine instead of the Newmark-Beta numerical algorithm. In order to solve modal equations of motion with initial conditions and take advantage of efficiencies gained when using uncoupled solution algorithms (like that within TRD1), an exact mode superposition method using MSC/NASTRAN DMAP has been developed and successfully implemented as an enhancement to an existing coupled loads methodology at the NASA Lewis Research Center. Author

N93-23740*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SOLVING MODAL EQUATIONS OF MOTION WITH INITIAL CONDITIONS USING MSC/NASTRAN DMAP. PART 2: COUPLED VERSUS UNCOUPLED INTEGRATION

Alan R. Barnett (Analex Corp., Brook Park, OH.), Omar M. Ibrahim (Analex Corp., Brook Park, OH.), Ayman A. Abdallah (Analex Corp., Brook Park, OH.), and Timothy L. Sullivan May 1993 12 p Presented at the 1993 MSC World Users' Conference, Arlington, VA, May 1993; sponsored by the MacNeal-Schwendler Corp.

(NASA-TM-106064; E-7670; NAS 1.15:106064) Avail: CASI HC A03/MF A01

By utilizing MSC/NASTRAN DMAP (Direct Matrix Abstraction Program) in an existing NASA Lewis Research Center coupled loads methodology, solving modal equations of motion with initial conditions is possible using either coupled (Newmark-Beta) or uncoupled (exact mode superposition) integration available within module TRD1. Both the coupled and newly developed exact mode superposition methods have been used to perform transient analyses of various space systems. However, experience has shown that in most cases, significant time savings are realized when the equations of motion are integrated using the uncoupled solver instead of the coupled solver. Through the results of a real-world engineering analysis, advantages of using the exact mode superposition methodology are illustrated. Author

N93-23745*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

MAPPING METHODS FOR COMPUTATIONALLY EFFICIENT AND ACCURATE STRUCTURAL RELIABILITY

Michael C. Shiao (Sverdrup Technology, Inc., Brook Park, OH.) and Christos C. Chamis Oct. 1992 23 p Proposed for presentation at the 33rd Structures, Structural Dynamics and Materials Conference, Dallas, TX, 13-15 Apr. 1992 Previously announced in IAA as A92-34321

(RTOP 553-13-00)

(NASA-TM-105892; E-7359; NAS 1.15:105892) Avail: CASI HC A03/MF A01

Mapping methods are developed to improve the accuracy and efficiency of probabilistic structural analyses with coarse finite element meshes. The mapping methods consist of the following: (1) deterministic structural analyses with fine (convergent) finite element meshes; (2) probabilistic structural analyses with coarse finite element meshes; (3) the relationship between the probabilistic structural responses from the coarse and fine finite element meshes; and (4) a probabilistic mapping. The results show that the scatter in the probabilistic structural responses and structural reliability can be efficiently predicted using a coarse finite element model and proper mapping methods with good accuracy. Therefore, large structures can be efficiently analyzed probabilistically using finite element methods. Author (revised)

N93-23746*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMPUTATIONAL SIMULATION FOR CONCURRENT ENGINEERING OF AEROSPACE PROPULSION SYSTEMS

C. C. Chamis and S. N. Singhal (Sverdrup Technology, Inc., Brook Park, OH.) Feb. 1993 23 p Presented at the 1992 AIAA Aerospace Design Conference, Irvine, CA, 3-6 Feb. 1992 Previously announced in IAA as A92-33285

(RTOP 323-57-40)

(NASA-TM-106029; E-7592; NAS 1.15:106029) Avail: CASI HC A03/MF A01

Results are summarized for an investigation to assess the infrastructure available and the technology readiness in order to develop computational simulation methods/software for concurrent engineering. These results demonstrate that development of computational simulation methods for concurrent engineering is timely. Extensive infrastructure, in terms of multi-discipline simulation, component-specific simulation, system simulators, fabrication process simulation, and simulation of uncertainties--fundamental to develop such methods, is available. An approach is recommended which can be used to develop computational simulation methods for concurrent engineering of propulsion systems and systems in general. Benefits and issues needing early attention in the development are outlined. Author (revised)

N93-23988 Minnesota Univ., Minneapolis.

A HIGHER-ORDER DIRECT BOUNDARY INTEGRAL-DISPLACEMENT DISCONTINUITY METHOD FOR FRACTURE PROPAGATION IN LAYERED ELASTIC MEDIA Ph.D. Thesis

Sakir Selcuk 1992 200 p

Avail: Univ. Microfilms Order No. DA9239154

This thesis presents the development of a direct boundary integral-displacement discontinuity method for plane-strain elastostatics boundary value problems in layered materials with cracks. Somigliana's identity for displacements inside an elastic region is extended to take account of crack-like geometries. The resulting boundary integral equations involve integrals with unknowns as the displacement discontinuities over the cracks. These equations are supplemented with traction boundary integral equations derived by differentiating the displacements. The kernel functions for the dual boundary integral equations are developed from the closed form solution to the problem of a concentrated force within one of two bonded half-planes in which the interface continuity conditions are fulfilled exactly. A four-layer elastic region with cracks is developed using a substructuring approach to construct one of the interfaces for the problem under consideration; the other two interfaces are automatically included by virtue of using the fundamental solution for the bonded half-planes. Quadratic variation boundary elements are used to model all boundary contours, cracks and the numerical interface. Crack tips are modeled with square-root variation boundary elements. All kernel-shape function products are integrated over straight-line boundary elements in closed form. Linear elastic mixed-mode fracture propagation criteria are reviewed and an algorithm based on the maximum circumferential tensile stress criterion is developed and incorporated into the numerical model for quasi-static crack propagation in layered materials. For cracks propagating away from a material interface, the criterion uses the linear elastic fracture mechanics solutions for stresses in the vicinity of a crack tip in a homogeneous region. The analytical solution for the stress field near the tip of an interfacial crack is used for the maximum tensile stress criterion to determine whether or not the crack will kink out of the interface. For cracks touching a material interface, the variation of the strength of the crack-tip stress singularity is not taken into account. Various example problems involving a circular hole and line cracks near or along material interfaces are used to compare the numerical results with the solutions available in the literature. Dissert. Abstr.

N93-23993# Brown Univ., Providence, RI. Div. of Engineering.

TWO-PARAMETER FRACTURE MECHANICS THEORY AND APPLICATIONS Interim Report

N. P. ODowd and C. F. Shih Nov. 1992 45 p

(Contract N00167-92-K-0038)

(AD-A259907; NUREG-CR-5958) Avail: CASI HC A03/MF A01

A family of self-similar fields provides the two parameters required to characterize the full range of high- and low-triaxiality crack tip states. The two parameters, J and Q, have distinct roles: J sets the size scale of the process zone over which large stresses and strains develop, while Q scales the near-tip stress distribution relative to a high triaxiality reference stress state. An immediate consequence of the theory is this: it is the toughness values over a range of crack tip constraint that fully characterize the material's fracture resistance. It is shown that Q provides a common scale for interpreting cleavage fracture and ductile tearing data thus allowing both failure modes to be incorporated in a single toughness locus. The evolution of Q, as plasticity progresses from small scale yielding to fully yielded conditions, was quantified for several crack geometries and for a wide range of material strain hardening properties. An indicator of the robustness of the J-Q fields is introduced; Q as a field parameter and as a pointwise measure of stress level is discussed. GRA

N93-24051# California Univ., Berkeley. Lawrence Berkeley Lab.

MECHANICS AND MECHANISMS OF CYCLIC FATIGUE-CRACK PROPAGATION IN TRANSFORMATION-TOUGHENED ZIRCONIA CERAMICS

M. J. Hoffman (Sydney Univ., Australia.), R. H. Dauskardt, R. O. Ritchie, and Y. W. Mai (Sydney Univ., Australia.) May 1992 23 p Presented at the AUSTCERAM 1992, Melbourne, Australia, 16-21 Aug. 1992

(Contract DE-AC03-76SF-00098)

(DE93-004716; LBL-32311; CONF-9208106-2) Avail: CASI HC A03/MF A01

Damage and cyclic fatigue failure under alternating loading in

transformation-toughened zirconia ceramics is reviewed and compared to corresponding behavior under quasi-static loading (static fatigue). Current understanding of the role of transformation toughening in influencing cyclic fatigue-crack propagation behavior is examined based on studies which altered the extent of the tetragonal-to-monoclinic phase transformation in MG-PSZ through subeutectoid aging. These studies suggest that near-tip computations of the crack-driving force (in terms of the local stress intensity) can be used to predict crack-growth behavior under constant amplitude and variable-amplitude (spectrum) loading, using spatially resolved Raman spectroscopy to measure the extent of the transformation zones. In addition, results are reviewed which rationalize distinctions between the crack-growth behavior of preexisting, 'long' (greater than 2 mm), through-thickness cracks and naturally-occurring, 'small' (1 to 100 micron), surface cracks in terms of variations in crack-tip shielding with crack size. In the present study, the effect of grain size variations on crack-growth behavior under both monotonic (R-curve) and cyclic fatigue loading are examined. Such observations are used to speculate on the mechanisms associated with cyclic crack advance, involving such processes as alternating shear via transformation-band formation, cyclic modification of the degree of transformation toughening, and uncracked-ligament (or grain) bridging. DOE

N93-24102*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.

BLADE ASSESSMENT FOR ICE IMPACT (BLASIM). USER'S MANUAL, VERSION 1.0

E. S. Reddy and G. H. Abumeri Apr. 1993 128 p

(Contract NAS3-25266; RTOP 505-62-OK)

(NASA-CR-191075; E-7733; NAS 1.26:191075) Avail: CASI HC A07/MF A02

The Blade Assessment Ice Impact (BLASIM) computer code can analyze solid, hollow, composite, and super hybrid blades. The solid blade is made up of a single material where hollow, composite, and super hybrid blades are constructed with prescribed composite layup. The properties of a composite blade can be specified by inputting one of two options: (1) individual ply properties, or (2) fiber/matrix combinations. When the second option is selected, BLASIM utilizes ICAN (Integrated Composite ANalyzer) to generate the temperature/moisture dependent ply properties of the composite blade. Two types of geometry input can be given: airfoil coordinates or NASTRAN type finite element model. These features increase the flexibility of the program. The user's manual provides sample cases to facilitate efficient use of the code while gaining familiarity. Author (revised)

N93-24121 Iowa State Univ. of Science and Technology, Ames.

USE OF THE CONVENTIONAL AND TANGENT DERIVATIVE BOUNDARY INTEGRAL EQUATIONS FOR THE SOLUTION OF PROBLEMS IN LINEAR ELASTICITY Ph.D. Thesis

Kuechler Muci and Karim Heinz 1992 151 p

Avail: Univ. Microfilms Order No. DA9302011

Regularized forms of the traction and tangent derivative boundary integral equations of elasticity are derived for the case of closed regions. The hypersingular and strongly singular integrals of the displacement gradient representation are regularized independently, through identities of the fundamental solution and its various derivatives, before the boundary integral equations are formed. Besides the displacements and the tractions, only the tangential derivatives of the displacements evaluated at the singular point appear in the regularized equations making them well suited for numerical treatment. The regularization of the hypersingular integrals demands that the displacement components have Holder continuous first derivatives at the singular point. Consistent with this requirement, the regularization of the strongly singular integrals is effective if the tractions and the unit vectors normal and tangent to the surface are continuous at that location. Higher order elements for two and three dimensional elastostatic problems are implemented through the coincident collocation of regularized forms of the displacement and the tangent derivative equations. The nodal values of the displacements, the fraction and their tangential derivatives are used as the degrees of freedom associated with the functional representative of the boundary variables. The tangential derivatives of the displacements and the tractions at the functional nodes are directly recovered from the boundary solution with comparable accuracy as the primative variables. Hence, the nodal values of the stress components are directly obtained through Hooke's law and need not be determined in a post processing manner. Several numerical examples demonstrate the advantages of the higher order elements versus the conventional ones. In two dimensions, four degrees of freedom per node Hermitian elements are used for functional interpolation only on those portions of the boundary where the gradients are high and quadratic Lagrangian elements are employed for the remaining parts of the modelled region. In three dimensions, nine degrees of freedom per node, incomplete quartic elements are employed for the approximation of the displacements and the tractions. Finally, the methodology presented here is general and can be extended to other problems amenable to a boundary integral formulation. Dissert. Abstr.

N93-24135# Puerto Rico Univ., Mayaguez. Dept. of General Engineering.

JOINT FLEXIBILITY EFFECTS ON THE DYNAMIC RESPONSE OF STRUCTURES. PART 1: DETERMINISTIC ANALYSIS Final Report

Luis E. Suarez and Enrique E. Matheu Dec. 1992 96 p

(Contract DAAL03-90-G-0214)

(AD-A260487; ARO-28374.5-EG-H) Avail: CASI HC A05/MF A01

The effect of the flexible connections on the dynamic behavior of structures was investigated. To take into account the uncertainties in their values, the stiffness of the connections are regarded as random variables. In the first part of the report, the problem is studied from a deterministic point of view in order to develop the analytical models and expressions required for a stochastic analysis. A bibliographic review of the deterministic analysis of structures with non-rigid joints and analysis of structures with random parameters is presented. A finite element model that includes the effect of the flexibility and finite size of the connections is formulated. By using a variational approach, it is shown that the mass matrix is also affected by the flexible connections. A sensitivity analysis is carried out to assess how the natural frequencies and modal shapes are affected by the variation in the stiffness of the joints. Closed form expressions to calculate the derivatives of the eigenvalues and eigenvectors are provided. GRA

N93-24207 Metcut Research Associates, Inc., Cincinnati, OH.

HIGH RELIABILITY RESIDUAL COMPRESSIVE STRESS PROCESSES. STATE-OF-THE-ART ASSESSMENT

John T. Cammett and Susan M. Moehring Sep. 1989 238 p Sponsored by National Center for Mfg. Sciences, Ann Arbor, MI

(PB93-127751; NCMS-88-MPM-14) Copyright Avail: Issuing Activity

The underlying purpose for the project is to improve the reliability and productivity of manufacturing processes that impart compressive residual stress (CRS). Recognizing that improvements in reliability, in particular, and productivity, in general, arise from development to effective and efficient process controls, one must first gain an understanding of the significant process parameters and their interactions. Thus, the specific aim of the project was to perform a state of the art survey assessment of CRS process parameters and control. Many of the findings of the survey focused on shot peening and other peening processes which are the most widely used of CRS processes; however, attention was given to many other CRS processes, including some for which CRS introduction is a process by-product and not the principal process aim. The report culminates in five recommendations for development work to be sponsored by the National Center for Manufacturing Sciences (NCMS) with intent to advance the state of the art in CRS processing. Author

N93-24208 Metcut Research Associates, Inc., Cincinnati, OH.

IMPROVED DYNAMIC STIFFNESS (SYSTEM MODELING), STATE-OF-THE-ART REVIEW

Apr. 1990 225 p Sponsored by National Center for Mfg. Sciences, Ann Arbor, MI

(PB93-127744; NCMS-88-PE-6) Copyright Avail: Issuing Activity

The report presents the results of work to assess the State of the Art of Dynamic Stiffness (System Modeling) as applied to machine tools and the machining process. The objectives of the project were to summarize current industrial practice and research activities, and identify needs and requirements for future efforts to improve the performance of machine tools in the area of dynamic stiffness. As the work progressed a pattern emerged and the study was organized into three major work areas: (1) dynamic system modeling of the machine tool structure; and (2) static and dynamic analysis of the combined machine tool structure/cutting process system (i.e., chatter prediction). Topics addressed included current analytical

and experimental methods, key case studies, leading researchers/institutions in the field, commercially available products, current practice, remaining technical problems, and future directions. GRA

N93-24242# Maryland Univ., College Park. Inst. for Physical Science and Technology.
ADAPTIVE HIERARCHIC MODELING OF PLATES AND SHELLS WITH A-POSTERIORI ERROR ESTIMATION Final Report
I. Babuska and Ch. Schwab Apr. 1992 31 p
(Contracts N00014-90-J-1030; F49620-92-J-0100)
(AD-A259941; BN-1133) Avail: CASI HC A03/MF A01

The problem of a-posteriori estimation of the modelling error and the adaptive modelling of plates is addressed in this paper. A family of models is proposed and upper and lower a-posteriori estimates of the modelling error in various norms are provided. The estimates are locally asymptotically exact. GRA

N93-24266# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
VARIATIONAL THEORY OF DEFORMATIONS OF CURVED, TWISTED, AND EXTENSIBLE ELASTIC RODS
Iradj G. Tadjbakhsh and Dimitris C. Lagoudas 18 Jan. 1993 18 p
(Contract DAAL03-92-G-0123)
(AD-A260331; ARO-30378.2-EG-URI) Avail: CASI HC A03/MF A01

The variational theory of three dimensional deformations of curved, twisted, and extensible elastic rods is obtained based entirely on the kinematical variables position and rotations. The constitutive relations that define the resistive couples and the axial force as gradients of the strain energy function are established. A candidate for the strain energy function on the basis of classical assumptions is presented. GRA

N93-24273# Maryland Univ., College Park. Inst. for Physical Science and Technology.
ON THE REGULARITY OF ELASTICITY PROBLEMS WITH PIECEWISE ANALYTIC DATA
B. Q. Guo and I. Babuska Jul. 1992 56 p
(Contract N00014-90-J-1030)
(AD-A260346; BN-1136) Avail: CASI HC A04/MF A01

This paper analyzes the regularity of plane elasticity problems with piecewise analytic data. The results are given in the frames of the countably weighted Sobolev spaces. These results are of major significance for the practical design and theoretical analysis of the p and h-p version of the finite element solutions of the elasticity problems. GRA

N93-24304# Missouri Univ., Rolla.
STUDIES IN PENETRATION MECHANICS Final Report
Romesh C. Batra Oct. 1992 160 p
(Contract DAAL03-89-K-0050)
(AD-A260436; ARO-26443.16-EG) Avail: CASI HC A08/MF A02

Steady state axisymmetric deformations of a thick thermoviscoplastic target being penetrated by a cylindrical penetrator also made of a thermoviscoplastic material have been studied. The materials of the target and the penetrator have been assumed to exhibit strain-rate hardening and thermal softening. In the second set of studies, the penetrator has been taken to be rigid, and the effect of friction at the target/penetrator interface, elasticity of the target material, and different flow rules used to model the target material have been analyzed. An engineering model capable of analyzing deformations of a viscoplastic target being penetrated by a rigid cylindrical rod has been developed. Various predictions from the model are found to match well with those from the finite element solution of the problem. GRA

N93-24409# Brown Univ., Providence, RI. Div. of Engineering.
COMPUTATION IN MECHANICS OF MATERIALS Final Report
R. J. Asaro, R. J. Clifton, and L. B. Freund 4 Jan. 1992 5 p
(AD-A260060) Avail: CASI HC A01/MF A01

The goal of this project, which was part of the DARPA Balanced Technology Initiative on Computational Mechanics, was to develop a comprehensive approach to the numerical modeling of the mechanical behavior of materials. Particular areas for focus in the project were the inelastic deformation of highly anisotropic materials such as single crystals and textured polycrystals, as well as evolving microstructural damage in ceramics and ductile metals in both slow and high rate deformation processes. While the contract was awarded for a period of four years, it was actually funded only for the first year plus a few months into the second year. Nonetheless, significant progress can be reported as a direct result of this project. GRA

N93-24426# Virginia Polytechnic Inst. and State Univ., Blacksburg.
LARGE-AMPLITUDE FORCED RESPONSE OF DYNAMIC SYSTEMS Final Report, 15 Oct. 1989 - 14 Oct. 1992
Ali. H. Nayfeh Nov. 1992 25 p
(Contract DAAL03-89-K-0180)
(AD-A260394; ARO-25630.32-EG) Avail: CASI HC A03/MF A01

The objective of this work was to study analytically, numerically, and experimentally the nonlinear dynamic behavior of metallic and composite structural elements to parametric and external excitations. The study was focused on resonance conditions that may produce large and possibly damaging motions. Special attention was given to modal coupling and consequent energy exchanges. GRA

N93-24479# Los Alamos National Lab., NM.
CRACK DEFLECTION AT BI-MATERIAL INTERFACES
I. E. Reimanis, A. L. Graham, J. J. Petrovic, and D. L. Tullock 1992 10 p Presented at the Ceramic Science and Technology Congress and Exposition, San Francisco, CA, 1-4 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003712; LA-UR-92-3885; CONF-921128-3) Avail: CASI HC A02/MF A01

Using the boundary element method (BEM), the effect of specimen geometry on crack deflection at interfaces is examined. We show that the results are nearly independent of specimen geometry for the case of a double-edged notch specimen. Our criteria agree well with recent criteria established analytically by He and Hutchinson (1992) for infinite specimen geometries; however, the results are dependent on the size of the crack length increments chosen for calculating the strain energy release rates. The implication is that the criteria depend on pre-existing flaws in the material. DOE

N93-24486# Alenia Spazio S.p.A., Rome (Italy). Gruppo Aerei Trasporto.
DAMAGE TOLERANCE APPROACH
A. Apicella 1991 20 p In ITALIAN
(ETN-93-93700) Avail: CASI HC A03/MF A01

The philosophy of damage tolerance is illustrated graphically under the subgroups of the objectives and analysis and of damage tolerance and analysis of fracture mechanics. The objectives of damage tolerance are to define relevant service characteristics and determine the characteristics from relevant statistics (standards), to guarantee structural integrity by damage tolerance analysis, and to full scale test the subcomponents. Flow diagrams for propagation analysis and residual strength analysis are included. ESA

N93-24529*# Texas Univ., San Antonio. Engineering Div.
PROMISC USER MANUAL, APPENDIX 2 Final Technical Report (Diskette Supplement)
Lola Boyce, Jerome P. Keating, and Thomas B. Lovelace Jan. 1990 31 p Diskette supplement: IBM compatible 5.25-inch DSDD
(Grant NAG3-867)
(NASA-CR-192989; NAS 1.26:192989; NONP-Suppl-DK-93-159796) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A09

This user manual documents the FORTRAN program PROMISC. The program performs a multiple linear regression on actual experimental or simulated experimental data for as many as eighteen effects or primitive variables, yielding regression coefficients that are the empirical material constants, ai, required by PROMISS (see Section 2.0, Theoretical Background). Included in this user manual are details regarding the theoretical background of both PROMISS and PROMISC, input data instructions and sample problems illustrating the use of PROMISC. Appendix A gives information on the primitive variables, their symbols, FORTRAN names and both SI and U.S. Customary units. Appendix B includes a disk containing the actual input and output files corresponding to the sample problems. The source code is available from the author at the address

given on the cover page of this report. Appendix C details the IMSL, Version 10, subroutines and functions called by PROMISC. The PROMISC89 program is included on a floppy disk. Author

N93-24530*# Texas Univ., San Antonio. Engineering Div.
PROMISS USER MANUAL, APPENDIX 1 Final Technical Report (Diskette Supplement)
Lola Boyce and Thomas B. Lovelace Jan. 1990 31 p Diskette supplement: IBM compatible 5.25-inch DSDD
(Grant NAG3-867)
(NASA-CR-192990; NAS 1.26:192990; NONP-Suppl-DK-93-159797) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A09

This user manual documents the FORTRAN program PROMISS (Vers. 2.0). The program determines the random strength of an aerospace propulsion component, due to a number of diverse random effects. Included in this user manual are details regarding the theoretical background of PROMISS, input data instructions and sample problems illustrating the use of both PROMISS and PROMISC. Appendix A gives information on the primitive variables, their symbols, FORTRAN names, and both SI and U.S. Customary units. Appendix B includes a disk containing the actual input and output files corresponding to the sample problems. The source code is available from the first author at the address given on the cover page of this report. Appendix C details the IMSL, Version 10, subroutines and functions called by PROMISS. Appendix D illustrates SAS/GRAPH (2) programs that can be used to plot both the probability density functions and the cumulative distribution functions. A floppy disk containing PROMISS89 is included. Author

N93-24571# Science Applications International Corp., San Diego, CA. Foreign Applied Sciences Assessment Center.
NONLINEAR DYNAMICS RESEARCH IN THE FORMER SOVIET UNION
H. D. I. Abarbanel, N. B. Abraham, A. M. Fraser, F. C. Moon, and E. A. Novikov Aug. 1992 216 p
(PB93-146496) Avail: CASI HC A10/MF A03

The report analyzes the capability in nonlinear dynamics research in the former Soviet Union. This is a broad area of research with implications in fields as diverse as cardiology, laser physics, oceanography, image processing, plasma dynamics, fluid physics, and population biology. Our focus was restricted to only a few topics in which the authors were able to bring together US experts in those fields. The areas of biological or medical applications, plasma physics, laboratory fluid dynamics, mathematical developments in integrable systems, and strength in mathematics are not treated in the report. GRA

N93-24589# Sydney Univ. (Australia). School of Civil and Mining Engineering.
INELASTIC NONUNIFORM TORSION OF STEEL I-BEAMS Research Report
G. Chen and N. S. Trahair Dec. 1991 37 p
(PB93-118776; R-647) Avail: CASI HC A03/MF A01

The paper presents a finite element model for analyzing the elastic-plastic nonuniform torsion behavior of thin-walled steel I-beams. The model uses Vlasov's warping strain model to represent warping torsion, and a mitre model for uniform torsion. The mitre model allows the representation at the tips of flanges of the transverse uniform torsion shear stresses. For elastic-plastic analysis, the incremental theory of plasticity is adopted, employing the Prandtl-Reuss flow rule and the von Mises yield criterion. The material state determination algorithm and the variable arc-length method are also employed to improve the accuracy and reliability of the solutions. The numerical integration over the cross section is carried out by dividing it into a number of triangular areas and then applying the no-bias area-coordinate Gaussian numerical integration scheme. The numerical examples provided show that good agreement is obtained with predictions of other models of inelastic nonuniform torsion and the experimental results by using the present finite element model. It is also concluded that the present model can predict more realistic results at higher rotations than other models which ignore the transverse uniform torsion shear stresses. GRA

N93-24593# Alenia Spazio S.p.A., Rome (Italy). Gruppo Aerei Trasporto.
BOUNDARY ELEMENT METHOD
A. Apicella 1991 28 p In ITALIAN
(ETN-93-93699) Avail: CASI HC A03/MF A01

The analysis of fatigue crack propagation laws using the boundary element method is discussed. Peculiarities of the calculation procedure are outlined, and a code developed for linear elastic two dimensional computation is described. An example of boundary and finite element methods is given. ESA

N93-24596* National Aeronautics and Space Administration. Pasadena Office, CA.
COMPOSITE PASSIVE DAMPING STRUTS FOR LARGE PRECISION STRUCTURES Patent
Benjamin P. Dolgin, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 20 Apr. 1993 9 p Filed 31 Aug. 1990 supersedes N91-13767 (29 - 5, p 678)
(Contract NAS7-918)
(NASA-Case-NPO-17914-1-CU; US-Patent-5,203,435;
US-Patent-Appl-SN-575697; US-Patent-Class-188-322.5;
US-Patent-Class-267-154; US-Patent-Class-267-141.2;
Int-Patent-Class-F16F-1/14) Avail: US Patent and Trademark Office

In the field of viscoelastic dampers, a new strut design comprises a viscoelastic material sandwiched between multiple layers, some of which layers bear and dampen load force. In one embodiment, the layers are composite plies of opposing orientation. In another embodiment, the strut utilizes a viscoelastic layer sandwiched between V-shaped composite plies. In a third embodiment, a viscoelastic layer is sandwiched between sine-shaped plies. Strut strength is equal to or greater than conventional aluminum struts due to the unique high interlaminar shear ply design. Official Gazette of the U.S. Patent and Trademark Office

N93-24639# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerospace.
STRUCTURAL IMPACT SIMULATION USING PROGRAM KRASH
J. C. Liaw, A. C. Walton, and J. C. Brown 1992 14 p Presented at International Conference on Emerging Technologies in Vehicle CAE and Structural Mechanics, Detroit, MI
(Cranfield-Aero-9010; SAE-900466; ISBN-1-871564441; ETN-93-93552)
Avail: CASI HC A03/MF A01; Cranfield Institute of Technology, Coll. of Aeronautics, Cranfield, Bedford MK43 OAL, England, HC

Use is made of the KRASH program to simulate a simplified car into barrier impact. The objectives are: to outline an approach to the simulation of vehicle structural impact dynamics through the use of a simplified frontal impact model; to identify, through the use of the model, structural features which determine the crash behavior of a car in a frontal barrier impact; to identify current limitations of the approach; and to outline future improvements. A step by step modeling technique is illustrated whose application at an early stage in the design process, allows an understanding of the contribution of individual components to the overall crash performance of a vehicle. ESA

N93-23939 Institute for Aerospace Research, Ottawa (Ontario). Structures and Materials Lab.
A NEW METHOD OF IMPACT TENSION TESTING OF ADHESIVELY-BONDED JOINTS
C. Poon, B. Farahbaksh (Alcan International Ltd., Kingston, Ontario.), and M. Heinze (Alcan Deutschland G.m.b.H., Goetingen, Germany.) *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 57-74 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

N93-23945 Aeronautical Research Labs., Taichung (Taiwan).
THE CHARACTERIZATION OF IMPACT PROPERTIES OF COMPOSITES Abstract Only
K. H. Tu and C. L. Ong *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 149 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

N93-23947 Stanford Univ., CA. Structures and Composites Lab.
DAMAGE IN LAMINATED COMPOSITES DUE TO LOW VELOCITY IMPACT Abstract Only
F. K. Chang *In* National Research Council of Canada, Airframe Materials Jul. 1991 p 153 (For primary document see N93-23935 08-24)
Copyright Avail: Canadian Inst. of Mining, Metallurgy and Petroleum, Xerox Tower 1210, 3400 de Maisonneuve Blvd., Montreal, Canada, H3Z 3B8

42 GEOSCIENCES (GENERAL)

N93-23823# Chen (W. T.) Co., Acton, MA.
INNOVATIVE INTERACTIVE EARTH SYSTEMS SCIENCE COURSEWARE FOR MIDDLE AND HIGH SCHOOL STUDENTS
W. T. Chen and G. Miller (WGBH Educational Foundation, Boston, MA.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1325-1327 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography.*

N93-22119# National Space Development Agency, Ohashi (Japan).
THE SECOND INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: PROCEEDINGS OF PRE ISY INTERNATIONAL SYMPOSIUM
Korehiro Maeda, ed. and Hironori Maejima, ed. et al 31 Jan. 1992 320 p Conference held in Ibaraki, Japan, 19 Nov. 1991 Original contains color illustrations
(JTN-93-80413) Avail: CASI HC A14/MF A03

The following topics were discussed: International Space Year (ISY) activities, Space Agency Forum on the International Space Year (SAFISY), remote sensing, earth observation, satellite imagery, environmental monitoring, earth resources management, land management, sea surface temperature, wind speed, sea and land ice remote sensing, forest management, remote sensing for fisheries, enlightenment of environmental monitoring for public, data management, data bases, data links, remote sensor, radiometers, MOS-1 (Marine Observation Satellite-1), natural disaster observation, desertification, air water interaction, ocean current, vegetative index. For individual titles, see N93-22120 through N93-22148.

N93-22120# National Space Development Agency, Tokyo (Japan).
OVERVIEW OF ISY PLAN
Tasuku Tanaka *In its* The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 1-11 (For primary document see N93-22119 08-43)
Avail: CASI HC A02/MF A03

Three expert panels established at the first Space Agency Forum on the International Space Year (SAFISY) and the earth science and technology projects concluded by those panels are outlined. Projects mentioned are as follows: (1) 13 projects in the area of earth science and technology; (2) 30 projects in the areas of education and applications; and (3) 27 projects in the area of space science. An overview of the following major ISY (International Space Year) events in Japan were presented: (1) the Asia-Pacific ISY Conference (APISYC) under the main theme Mission to planet earth, the most important ISY event in Japan, in which the discussion will be focused on how satellite remote sensing data can be utilized to predict global changes; (2) the ISY seminar on Tropical eco-system held in Thailand as part of the SAFISY project monitoring and management of vegetation resources; (3) the Polar ice extent workshop held in Hokkaido to detect the ice motion in the Northern Hemisphere by two synthetic aperture radar onboard the ERS-1 and the Japanese Earth Resources Satellite-1 (JERS-1); and (4) the ISY memorial Engineering Test Satellite-5 (ETS-5) Pan-Pacific communication pilot project for testing concise satellite communication for education and application to developing countries in the Asia Pacific region. Author (NASDA)

N93-22121# National Space Development Agency, Ohashi (Japan). Earth Observation Center.
OVERVIEW OF EARTH ENVIRONMENT DATA SET: MOS-1/MOS-1b DATA SETS
Korehiro Maeda and Hironori Maejima *In its* The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 13-45 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

The Earth environment is getting worse due to the expansion of the activity of human beings. In order to resolve environment problems, it is necessary to monitor environment globally and continuously from space by earth observation satellites. NASDA (National Space Development Agency of Japan) is a leading agency for sea surface temperature and polar ice extent among several ISY (International Space Year) projects. NASDA is also contributing to the other projects such as vegetation. In this paper, types and format of MOS-1 (Marine Observation Satellite-1)/MOS-1b (Marine Observation Satellite-1b) data sets are reported and some evaluation results and future environment data sets are described. Author (NASDA)

N93-22122# Kanagawa Univ., Yokahama (Japan). School of Science.
OVERVIEW ON ACTIVITIES OF ISY GSST WORKING GROUP IN JAPAN
Toshihiko Teramoto *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 49-54 (For primary document see N93-22119 08-43)
Avail: CASI HC A01/MF A03

This paper introduces how the ISY (International Space Year) GSST (Global Sea Surface Temperature) Working Group is established and what the aim of the Working Group is. Then, titles of main on-going studies are presented. Author (NASDA)

N93-22123# Iwate Univ., Morioka (Japan). Dept. of Computer Science.
OBSERVATION SYSTEM FOR SEA SURFACE TEMPERATURE VALIDATION TEST IN MUTSU BAY
Ryuzou Yokoyama, Sumio Tanba, Takashi Souma, Hironori Maejima, and Korehiro Maeda *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 55-67 Prepared in cooperation with National Space Development Agency, Saitama, Japan (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

An accuracy validation test project for the Sea Surface Temperature (SST) estimation by satellite data is undertaking in Mutsu Bay. The sea and air truth data are provided by the following four observation systems operated by independent organizations: (1) Mutsu Bay Automatic Buoy System (MBABS); (2) Automatic Meteorological Data Acquisition System (AMeDAS); (3) Sea Surface Temperature Profiler Buoy (SSTPB); and (4) Radio Sonde Observation System (RSOS). The satellite SST is combined with the sea truth SST by MBABS to form match-ups for the validation test. Their temporal and spatial coincidences are guaranteed to be within 30 minutes and one pixel resolution, respectively. The data of AMeDAS, SSTPB and RSOS can be effectively referred in the error analysis of the SST estimation. Author (NASDA)

N93-22124# Toba Merchant Marine Coll. (Japan).
MONITORING OF KUROSHIO CURRENT USING THE DATA OF VTIR OBTAINED BY MOS-1 AND MOS-1b Abstract Only
Hiroaki Ochiai *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 69-71 (For primary document see N93-22119 08-43)
Avail: CASI HC A01/MF A03

Kuroshio current, the most big scale warm current in the world, flows towards the north east direction along the southern coast of Kyushu, Shikoku and Honshu Island of Japan in normal conditions. But, when cold water mass is formed in a big scale by up-welling in the Sea of Kumano or Enshu, the flow pattern of Kuroshio current changes to a meandering pattern influenced by cold water mass and the environmental condition of the Sea of Kumano or Enshu in coastal areas became quite different from that when the Kuroshio current's flow pattern is normal. In this study, monitor of the flow pattern of Kuroshio current and ebb current are tried using the VTIR (Visible and Thermal Infrared Radiometer) data obtained by MOS-1 (Marine Observation Satellite-1) and MOS-1b (Marine Observation Satellite-1b), and several remarkable results are carried out. Although the resolution of VTIR is less than that of NOAA AVHRR (Advanced Very High Resolution Radiometer), it is recognized to be very effective to monitor the flow pattern of Kuroshio current and its surrounding area through the year. Author (NASDA)

N93-22125# Tohoku Regional Fisheries Research Lab., Miyagi (Japan).
SEA SURFACE TEMPERATURE: OBSERVATION IN OFF-SHORE OF SANRIKU

Denzo Inagake and Akira Tomosada *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 73-81 (For primary document see N93-22119 08-43)

Avail: CASI HC A02/MF A03

Satellite infrared sensors can detect a lot of small scale phenomena at the sea surface such as streamers, frontal eddies and the others, which cannot be found out by ordinary hydrographic surveys. But there remains some issues whether all of these phenomena are real ones, because the satellite sensors observe just the sea surface where the air-sea interaction is very active. It is necessary to distinguish what kind of phenomena are real ones or only illusions. On May 15, 1989, a warm streamer around the Kuroshio warm-core ring was visible in a NOAA-10 AVHRR (Advanced Very High Resolution Radiometer) image. The warm streamer was observed by hydrographic survey on board the Research Vessel Souyou Maru during May 20-22, 1989. The warm streamer around the warm-core ring had a structure beyond 500 meters depth. Also another warm streamer was observed in the warm-core ring. In this paper,, the structure of the warm streamer from its generation to spiraling in the Kuroshio warm-core ring and the development using the MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) and NOAA AVHRR images are reported. Author (NASDA)

N93-22126# Maritime Safety Agency, Tokyo (Japan). Hydrographic Dept.
OBSERVATION IN THE EAST CHINA SEA

Masataka Hishida *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 83-96 (For primary document see N93-22119 08-43)

Avail: CASI HC A03/MF A03

NOAA-AVHRR image data is very usefull to analyze the ocean state of the East China Sea (ECS). It is important to clarify SST distribution of ECS because of the complexity that exists in the current system of the Kuroshio and it's branch as for example the Tsushima warm current (TC), the Yellow Sea warm current (YSC), adding warm eddy, cool water intrusion and otherwise tidal current. Some oceanographical data like as current data using ADCP and Argos bouy, temperature data using XBT, CTD and surface water sampling were gathered by the survey vessel of Shoyo in the cruise of KER (Kuroshio Exploitation Research). Those data were compared with the AVHRR data. The separate area of TC and YSC from the Kuroshio were made a guess and cool eddy and intrusion recognized by these data. Author (NASDA)

N93-22127# Saga Univ. (Japan). Dept. of Information Science.
ESTIMATION OF PARTIAL CLOUD COVER WITHIN A PIXEL

Kohei Arai *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 97-106 (For primary document see N93-22119 08-43)

Avail: CASI HC A02/MF A03

A comparative study on estimation of partial cloud cover within a pixel has been conducted for use of the pixels partially suffered from cloud cover in sea surface temperature estimation. The estimation accuracies derived from four methods, the method using a brightness temperature difference between 3.8 micrometer and 11 micrometer wave length channels of NOAA/AVHRR (Advanced Very High Resolution Radiometer) and three methods based upon inversion problem solving, were compared. The experimental results with NOAA/AVHRR and MOS-1 (Marine Observation Satellite-1)/VTIR (Visible and Thermal Infrared Radiometer) data show almost same estimation accuracy of around percent in terms of RMS (Root Mean Square) error in cloud cover estimation. Also from the experimental results with simulated data, it was found a relationship among an observation noise, mixing ratio and estimation accuracy in case for the variance of cloud was greater than that of the ocean. In such cases estimation accuracy decreases in accordance with increasing of cloud cover and observation noise. Non-linear maximum likelihood estimation which is one of the methods based on inversion problem solving shows a good estimation accuracy compared to the other methods. In particular in case for the number of classes which designated for proportion estimation (in this case two classes, cloud and the ocean) is greater than the number of channels, or dimensionality of the observation vector, non-linear maximum likelihood estimation is superior to the other methods based on the best linear estimation and least square method. Author (NASDA)

N93-22128# Meteorological Research Inst., Tsukuba (Japan).
ELIMINATION OF ABSORPTION EFFECT OF ATMOSPHERIC GASES AND STRATOSPHERIC AEROSOL BY COMBINED USE OF IR AND MICROWAVE DATA

Yozo Takayama *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 107-117 Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N93-22119 08-43)

Avail: CASI HC A02/MF A03

Simulation studies on deriving Sea Surface Temperature (SST) by combining use of IR (Infrared) data from Visible and Thermal Infrared Radiometer (VTIR) and two frequency channels data from Microwave Scanning Radiometer (MSR), both on board MOS-1 (Marine Observation Satellite-1), are presented. For estimating SST the dual frequency (23.8, 31.4 GHz) microwave channels data have the same capability as IR split window (11, 12 mm) technique to correct atmospheric absorption effect. Moreover in case of MOS-1 VTIR and MSR data, estimated SST is better by using MSR dual-frequency channels to correct atmospheric absorption than by using VTIR split window, because for correction of the absorption effect effective signal to noise ratio of VTIR split window which have relatively coarse quantization of brightness temperatures, is lesser than that of MSR dual-frequency. Further the microwave dual frequency technique is superior in correction for stratospheric aerosol absorption to the IR split window technique, because stratospheric aerosol little absorb the radiation from earth surface in the microwave frequencies regions, whereas VTIR split window channels affected by it. A method to derive SST by using single IR window channel and dual frequency channels of MSR is proposed to reduce stratospheric aerosol effect upon estimation of SST when dense stratospheric aerosol layer is formed after a big volcanic eruption.
Author (NASDA)

N93-22129# Hokkaido Univ. of Education, Iwamizawa (Japan).
OVERVIEW OF ACTIVITIES OF ISY PIE COMMITTEE

Fumihiko Nishio *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 121-138 (For primary document see N93-22119 08-43)

Avail: CASI HC A03/MF A03

An overview of the activities of the International Space Year (ISY) Working Group on Polar Ice Extent (PIE), one of the earth science and technology projects of the Space Agency Forum (SAF) on ISY, are presented. The following topics were discussed: (1) processes of the four meetings held since its inauguration in January 1990; (2) five research items for ISY and their details, data sources, research participant countries, etc. (real-time ice monitoring and possibility of forecast, global arctic and antarctic brightness temperature data sets, ice movement and sea ice thermodynamics, sea ice modeling, and assimilation and/or integration of data set); (3) the subject of ISY PIE workshop in Japan on 1993 will be

focused on results of sea ice and land ice studies by satellite data and special topics on the sea ice and oceanography on the Sea of Okhotsk; and (4) the chronological variation of sea ice extent on the Sea of Okhotsk and the sea surface temperature on the eastern equatorial Pacific Ocean which shows the correlation between sea ice extent on the Sea of Okhotsk and La Nina event (followed by El Nino) on the equatorial eastern Pacific. Author (NASDA)

N93-22130# National Inst. of Polar Research, Tokyo (Japan).
SEA ICE AND GLACIER IN THE ANTARCTIC FROM PASSIVE MICROWAVE OBSERVATION
Takashi Yamanouchi, Hiroshi Kanazawa, Makoto Wada, Sadao Kawaguchi, Fumihiko Nishio (Hokkaido Univ. of Education, Iwamizawa, Japan.), Kouhei Cho (Remote Sensing Technology Center, Tokyo, Japan.), and Korehiro Maeda (National Space Development Agency, Saitama, Japan.) *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 139-151 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

Data of MOS-1 (Marine Observation Satellite-1)/MOS-1b (Marine Observation Satellite-1b) have been acquired at Syowa Station by the Japanese Antarctic Research Expedition. From the data of Microwave Scanning Radiometer (MSR) of 23.8 and 31.4 GHz, many parameters are to be derived for the sea ice, firn covered glacier and ice sheet in the polar cryosphere, together with the atmospheric water vapor and cloud liquid water content over the ocean. For the polar firn over the ice sheet, microwave brightness temperature shows a large variation according to the physical temperature and firn properties. For the further quantitative discussion, it is needed to use emissivities calculated from the mean brightness temperature or vertical temperature profile within the firn layer. The data of airborne microwave observation were used to interpret satellite data and a clear relation to the accumulation rate was obtained, which had been explained by the snow grain size using radiative transfer model of the firn layer. It is found to be difficult from the low resolution satellite microwave data to describe the large variation of accumulation rate near the coast, ablation zone-blue ice zone, where the snow melting occurs in summer time and high accumulation belt. The airborne microwave observations are worth continuing to monitor the variation of high accumulation area. A plan for ISY (International Space Year) data sets for Polar Ice Extent based on MOS-1 data is proposed, which will be helpful for the analysis of sea ice and ice sheet surface. Author (NASDA)

N93-22131# Hokkaido Univ., Sapporo (Japan). Sea Ice Research Lab.
DRIFTING ICE IN THE SEA OF OKHOTSK
Masaaki Aota and Fumihiko Nishio (Hokkaido Univ. of Education, Iwamizawa, Japan.) *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 153-159 (For primary document see N93-22119 08-43)
Avail: CASI HC A02/MF A03

An overview of the study on the drifting ice on the Sea of Okhotsk using satellite, aircraft, coastal radar data, and Multi Spectral Scanning Radiometer (MSSR) data is presented. Not only the extent of sea ice cover but the presence of polynyas and leads are significant to the energy budget of the ice covered ocean and the local and regional climate for changing atmospheric circulation. Data analysis of the distribution and movement of the drift ice off the Sea of Okhotsk coast of Hokkaido observed by the radar network established from 1966 to 1968 showed that the number of days in which sea ice is recognized on radar image was significantly correlated with the sea surface temperature on the equatorial eastern Pacific Ocean. The chronological variation of sea ice extent on the Sea of Okhotsk acquired by various methods such as satellites, aircraft, ships, coastal radars, and MSSR correlates with sea surface temperature anomaly on the eastern equatorial Pacific Ocean (La Nina and El Nino). Author (NASDA)

N93-22132# Ministry of Posts and Telecommunications, Tokyo (Japan). Microwave Remote Sensing Section.
MICROWAVE REMOTE SENSING OF ICE
Kenichi Okamoto *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 161-173 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

Remote sensing of ice by radiowaves, especially by spaceborne microwave remote sensor is reviewed. Especially, usefulness of synthetic aperture radars, microwave scatterometer and microwave radiometers for the remote sensing of sea ice is shown. Also, the remote sensing of continental ice by the microwave altimeter and synthetic aperture radar is introduced. Author (NASDA)

N93-22133# Japan Marine Science and Technology Center, Tokyo.
OBSERVATION IN ARCTIC
Kiyoshi Hatakeyama *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 175-187 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

Japan Marine Science and Technology Center (JAMSTEC) initiated arctic study from 1991, and the first extensive observation was made in summer. And the part of this program is internationally going on with many overseas organizations. The goal of this study is to establish some phenomenological models of arctic ocean, atmosphere, and snow and ice to express and predict their variabilities. Some of them, for example, arctic sea ice model may well predict the green house effect of the earth, which is one of the greatest concerns to human beings. This project is a long term plan over a period of 20 years. The first phase five years, from 1991 to 1995, a general form using observation by ship, automatically station buoy, and satellite has been made up. Author (NASDA)

N93-22134# Tokyo Univ. (Japan). Inst. of Industrial Science.
VEGETATION DISTRIBUTION OF SOUTH EAST ASIA Abstract Only
Shunji Murai, Yoshiaki Honda, Masataka Takagi, Teruyuki Ito, and Isao Abe *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 191-193 (For primary document see N93-22119 08-43)
Avail: CASI HC A01/MF A03

In South East Asia, ecosystem is changed by commercial logging or shifting cultivation. Accordingly, it is necessary to control the natural environmental condition. A current vegetation map is useful to plan prevention of ecosystem change. Therefore, it was attempted to examine vegetation distribution of South East Asia. A global vegetation map has been generated with NOAA GVI (Global Vegetation Index) data. However, it has low resolution and low accuracy to watch South East Asia. Therefore a MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data, which has two advantages, i.e., the resolution is higher than NOAA and MOS-1 data is cheaper than other satellite data (LANDSAT TM (Thematic Mapper) or SPOT), was selected. The data is synthesized more than 300 images which are resampled to 10 sec mesh size. And the vegetation map is generated using NVI (Normalized Vegetation Index) value. Moreover the vegetation distribution of each country (Thailand, Cambodia, Laos, Vietnam) is examined. Author (NASDA)

N93-22135# Forestry and Forest Products Research Inst., Ibaraki (Japan). Remote Sensing Lab.
MONITORING OF GROWTH ENVIRONMENT OF FOREST
Haruo Sawada *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 195-203 (For primary document see N93-22119 08-43)
Avail: CASI HC A02/MF A03

This study aims to apply the vegetation index for mapping and zoning the environmental condition of forest land using MOS (Marine Observation Satellite) MESSR (Multispectral Electronic Self-Scanning Radiometer) data. It is considered that the seasonal changes of the spectral reflectance from vegetation are the most important factor for evaluating the environmental conditions of forest growing. Several seasonal data were collected and used for this study for obtaining the phenological conditions of forest land from satellite remote sensing data. Especially, data of dry seasons were gathered and the changes of the Normalized Vegetation Index (NVI) derived from the MOS MESSR data in Thailand where typical seasonal tropical forests are dominant were analyzed. The NVI values change depending

upon their terrestrial positions and vegetation cover types. The summations of the NVI values is considered to indicate the length of the well vegetated period. The data of each pixel is influenced by the terrestrial environmental condition and vegetation differences. And the segmentation method is necessary for zoning the environmental conditions based on the hypothesis that the environmental conditions make the differences of vegetation types of the area. MOS-1 (Marine Observation Satellite-1) data are found effective for zoning the environmental conditions of vegetated area based on the NVI data, although it is still necessary to continue to collect the data and store them in the systematic data base system. Author (NASDA)

N93-22136# Teikyo Univ., Utsunomiya (Japan). School of Science and Engineering.

INVESTIGATION OF THE SURFACE CONDITION IN TAKLIMAKAN DESERT

Kiyoshi Tsuchiya, Takashi Ishiyama (Chiba Univ., Japan.), and Shigehiko Sugihara (Institute of Physical and Chemical Research, Saitama, Japan.) *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 207-226 In ENGLISH and JAPANESE (For primary document see N93-22119 08-43)

Avail: CASI HC A03/MF A03

As a part of Japan China cooperative research project on the mechanism of desertification, in situ surveys and satellite data analysis were made for the Hotan and Akusu areas located in the southern part and on the northern border of Taklimakan Desert respectively. Following results are obtained through analysis of obtained data: (1) it is possible to classify desert, semi-desert and vegetated areas based on the available satellite data, however it is not easy to classify vegetation type and the desertified area in the several years. Addition of more high resolution satellite data together with development of analysis technique is necessary; (2) in Hotan area located in the southern part of the desert the daytime surface temperature reached as high as above 62 C in late September while it was 42 C in late October. Below the surface, soil temperature dropped sharply reaching 30 C and 20 C at 5 cm depth in late September and October respectively. Large radiation cooling was observed at night in late October reaching as low as 2 C at the ground surface; and (3) precipitable water (atmospheric water vapor content) around the Taklimakan desert in late October in 1990 was around mm with a fairly large variation in a few days. Author (NASDA)

N93-22137# Science and Technology Agency, Tokyo (Japan). National Research Inst. for Earth Science and Diaster.

VERIFICATION OF EFFECTIVENESS OF MOS-1b DATA IN DISASTER AREA

Shigetsugu Uehara, Shinobu Yazaki, Toshikazu Morohoshi, Atsushi Takeda, Hideomi Nakamura, and Isao Watabe *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 229-239 (For primary document see N93-22119 08-43)

Avail: CASI HC A02/MF A03

In this verification study, the following four cases were analyzed: (1) detection of disaster conditions due to Unzendake volcanic eruptions based on the MESSR (Multispectral Electronic Self-Scanning Radiometer) data taken on September 8, 1991 comparing with the one taken before the disaster on June 13, 1988; (2) assessment of disaster conditions over the areas around Pinatubo Volcano, Philippines, due to the big explosions in the mid June 1991 and successive storms based on the MESSR data taken on July 5 comparing with the one taken before the disaster on April 19, 1991; (3) assessment of the big tropical cyclone accompanying the severest storm surge attacked Bangladesh coastal areas based on the VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) data taken on April 29 and 30, 1991 in the midst of the disaster occurrence and the MSR data taken May 8 after a week of the disaster as well as the ones taken on April 4, 1991, 25 days before the disaster; and (4) assessment of sea ice conditions over the Okhotsk Sea based on VTIR data taken on February 27 and MESSR data on February 26, 1991. Through these case studies, various useful informations could be obtained. Author (NASDA)

N93-22138# Meteorological Satellite Center, Tokyo (Japan). Analysis Div.

UPPER-AIR CIRCULATION SYSTEMS

Masami Tokuno *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 243-254 (For primary document see N93-22119 08-43)

Avail: CASI HC A03/MF A03

The imageries of 6.7 micrometers Water Vapor (WV) channel from NOAA/HIRS (High Resolution Infrared Sounder) (Channel 12) and MOS-1 (Marine Observation Satellite-1)/VTIR (Visible and Thermal Infrared Radiometer) (Channel 2) are studied for the analysis of upper-air circulation systems. The results indicate the availability of the patterns on WV imagery to analyze significant upper-air flow features associated with troughs and jet streams, and the capability of sequences of the HIRS/WV imageries to synoptic-scale analysis. These results suggest that the WV imageries from NOAA/HIRS and MOS-1/VTIR are useful for the analysis of upper-air circulation systems. Author (NASDA)

N93-22139# Meteorological Research Inst., Tsukuba (Japan).

INTERANNUAL VARIATIONS OF SEA SURFACE WIND SPEED, WATER VAPOR RETRIEVED FROM SPECIAL SENSOR MICROWAVE/IMAGER: EL NINO/LA NINA COMPARISON

Akira Shibata *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 255-265 (For primary document see N93-22119 08-43)

Avail: CASI HC A02/MF A03

Column water vapor and surface wind speed retrieved from the data of Special Sensor Microwave/Imager (SSM/I) are validated by truth data of upper air observation and ocean buoy data. Interannual variations of column water vapor and surface wind speed are investigated by data sets of them from July 1987 through June 1990. Data sets of these SSM/I's geophysical parameters showed interannual variations concerning with El Nino and La Nina in the tropical Pacific Ocean. The reversed pattern of surface wind speed is also found in the Atlantic Ocean and Northern Pacific Ocean. Author (NASDA)

N93-22140# Japan Weather Association, Tokyo. Meteorological Information Center.

DATA SETS FOR WEATHER INFORMATION SERVICES c47

Sei-Ichi Saitou and Rikuyo Morimoto *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 267-276 (For primary document see N93-22119 08-43)

Avail: CASI HC A02/MF A03

Weather information service is very important for daily life and activities. Data sets for weather information services consists of alphanumeric data and image/graphics data. This paper describes the outline of data sets for weather information services and data distribution of these data sets by on-line network system. Author (NASDA)

N93-22141# Japan Fisheries Information Service Center, Tokyo.

DATA SET FOR FISHERIES: WHY CAN FISHING GROUNDS BE MONITORED BY DATA SET OF MOS-1b VTIR

Hideo Tameishi, Osamu Honda, Toshiyuki Kouguti, Shin Fujita, and Katsuya Saitou *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 279-289 (For primary document see N93-22119 08-43)

Avail: CASI HC A02/MF A03

JAFIC (Japan Fisheries Information Service Center) makes the satellite aided oceanographic condition charts with NOAA AVHRR (Advanced Very High Resolution Radiometer) data and sends these charts to fishing vessels in ocean. Because, it is shown that the NOAA AVHRR data are applicable to fishing ground forecasting. The indexes of fishing ground forecasting are as follows: (1) the most favorable temperature range of a target fish; (2) an oceanographic environment such as warm/cold current, warm/cold eddy, front and intrusion of warm/cold water which is produced as a fisheries oceanographic chart by JAFIC; (3) ocean color which corresponds to distribution of phytoplankton, that is fray condition. However, the ocean color is not described in this article but for further study in future; and (4)

a discriminant prediction system of skipjack fishing ground formation developed by JAFIC using the NOAA AVHRR data (1982-1985.) The discriminant prediction formula is F = 0.32X(sub 1) + 0.36X(sub 2) + 0.88X(sub 3). Besides, the JAFIC applied these results to the data set imageries of MOS-1b (Marine Observation Satellite-1b) VTIR (Visible and Thermal Infrared Radiometer), and it was clarified the MOS-1b VTIR data set imageries is as useful as NOAA AVHRR imageries on fine day.
Author (NASDA)

N93-22142# Tokai Univ., Tokyo (Japan). Research and Information Center.

LASER DISC FOR EARTH ENVIRONMENT DATA SET Abstract Only **c82**

Haruhisa Shimoda and Toshibumi Sakata *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 293-295 (For primary document see N93-22119 08-43)
Avail: CASI HC A01/MF A03

Global change problems are one of the most critical problems for humankind. However, the actual state of the problem is not well known by public. The best way to enlighten them is to show images of global change taken from earth observation satellites. The goal of this project is to develop a data set of images taken from satellites, and let people (especially young students) to be aware of global change, to understand the state of the art of the earth, to be concerned with earth environmental monitoring activity and to contribute to preservation of global environment. Laser disc (video disc) was selected as a media of this data set, because it is widely spread and has the capability to show both still and moving images. The configuration of this data set is as follows: (1) history of earth observations; (2) earth observation satellite MOS-1 (Marine Observation Satellite-1); (3) international cooperation for global environmental monitoring; and (4) MOS-1 MESSR (Multispectral Electronic Self-Scanning Radiometer) images of Japan. Cooperating with NASDA (National Space Development Agency of Japan)/RESTEC (Remote Sensing Technology Center of Japan), Tokai University is preparing for editing of data set and laser disc installation in order to contribute to ISY (International Space Year) projects.
Author (NASDA)

N93-22143# Canada Centre for Remote Sensing, Ottawa (Ontario). Ice Applications.

ENVIRONMENTAL DATA SETS IN CANADA **c82**

Michael J. Manore *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 299-310 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

Because of its very large land mass, the collection of environmental data sets in Canada has historically been a difficult and expensive proposition. Responsibility for the compilation and maintenance of such data sets does not rest with a single body, but rather with a broad range of discipline-specific agencies in meteorology, forestry, oceanography, agriculture, geology, and topographic mapping. Only recently have the large number of environmental data bases in Canada been catalogued with an eye towards making the most valuable ones widely available for research purposes. Relating to the ISY (International Space Year), Canada is the leader of the exciting 'Global Change Encyclopedia' project which bring together a wide variety of regional and global data sets on CD-ROM for publicity and educational purposes. Author (NASDA)

N93-22144# European Space Agency. ESRIN, Frascati (Italy). Earthnet Programme Office.

ESA EARTHNET ACTIVITIES RELATED TO THE GLOBAL ENVIRONMENTAL DATA NETWORK

G. M. Pinna and V. Beruti *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 311-324 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

European Space Agency (ESA) strategy for data management of earth observation missions, data management policy, acquisition and maintenance of data bases by the Earthnet Programme Office, the objectives, elements, implementation strategy, present status of the global environmental data network, Earth Observation (EO) World Information Center, and high-level structure of the network are outlined. This presentation is represented by viewgraphs only. Author (NASDA)

N93-22145# National Research Council, Bangkok (Thailand). Remote Sensing Center.

ENVIRONMENTAL DATA SET IN THAILAND **c82**

Chanchai Peanvijarnpong *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 325-340 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

An overview of the governmental organization structure and the efforts for acquiring and utilizing remote sensing data in Thailand is presented. Following are the environment data sets acquired by satellite remote sensing: (1) administrative data set; (2) forest data set; (3) land utilization data set; (4) annual rainfall data set; (5) topographical data set; (6) land form data set; (7) geological data set; (8) elevation data set; (9) agricultural data set; and (10) river and water resource data set. Author (NASDA)

N93-22146# Alaska Univ., Fairbanks. Geophysical Inst.

ENVIRONMENTAL DATA SETS AT THE UNIVERSITY OF ALASKA **c82**

J. M. Miller and T. H. George *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 341-347 (For primary document see N93-22119 08-43)
Avail: CASI HC A02/MF A03

The following activities of the Geo Data Center are introduced: (1) LANDSAT Multi Spectral Scanner (MSS) data collection indexed by an on-line system which is listed in the NASA Global Change Master Directory; (2) Advanced Very High Resolution Radiometer (AVHRR) data collection acquired in three spectral bands; (3) ERS-1 Synthetic Aperture Radar (SAR) data collection; (4) derived data products by the Alaska SAR Facility (ASF) on sea ice and ocean such as ice motion vectors, ice-type classification, ice-type fraction, and wave vectors; and (5) the Japanese Earth Resources Satellite-1 (JERS-1) SAR and Optical Sensor (OPS) data acquisition and processing. Author (NASDA)

N93-22147# Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Oceanography.

ENVIRONMENTAL DATA SETS FOR INTERNATIONAL SPACE YEAR ACTIVITIES IN AUSTRALIA **c82**

Carl S. Nilsson and Jeff Kingwell (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia.) *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 349-354 (For primary document see N93-22119 08-43)
Avail: CASI HC A01/MF A03

An overview of the following sources of environmental and geophysical data available to support Australian International Space Year (ISY) activities was presented: (1) international land cover change project, one of the space data for global change projects, to demonstrate techniques which could be used for operational monitoring natural land cover change; (2) sea surface temperature and ocean productivity projects including participation in the ISY productivity of the Global Ocean; (3) participation in the joint Centre National d'Etudes Spatiales (CNES)/NASA Topography Experiment for Ocean Circulation (TOPEX) POSEIDON ocean altimetry program; (4) participation in the ERS-1 and the Japanese Earth Resources Satellite-1 (JERS-1) missions; and (5) NOAA catalogue and data archives.
Author (NASDA)

N93-22148# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

THE BRAZILIAN CONTRIBUTIONS FOR THE INTERNATIONAL SPACE YEAR, 1992

Roberto PereiradaCunha *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 355-363 (For primary document see N93-22119 08-43)
Avail: CASI HC A02/MF A03

The following aspects of Brazilian contribution (mainly by the Instituto de Pesquisas Espaciais (INPE)) and initiatives for the International Space

Year (ISY) are outlined: (1) participation in the ISY world forest watch by two approaches, global monitoring (1 km resolution coverage) and regional monitoring (Pan-Amazonia project, joint study by INPE, NASA, and other Latin-American organizations to evaluate the deforestation of the whole Amazonia); (2) the forest Brazilian satellite, a data collection platform satellite; (3) participation in assembling forty image LANDSAT digital mosaic for Amazonia region, examples of global change atlas project sponsored by Austria; and (4) establishment of a visitor center as permanent exhibition hall. Other regional forest monitoring projects are also cited.

Author (NASDA)

N93-22436# European Space Agency, Paris (France).

PROCEEDINGS OF SIXTH USER SEMINAR OF THE GERMAN REMOTE SENSING DATA CENTRE OF THE GERMAN AEROSPACE RESEARCH ESTABLISHMENT (DLR)

Rudolf Winter (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany.) and Winfried Markwitz (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany.) Aug. 1992 85 p Transl. into ENGLISH of Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 94 p Seminar held in Oberpfaffenhofen, Germany, 18-19 Sep. 1989 Original language document was announced as N91-12992

(ESA-TT-1245; DLR-Mitt-90-09; ETN-93-93584) Avail: CASI HC A05/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Papers discussing the potential for using the data from the NOAA, LANDSAT and ERS-1 satellites are presented. The main emphasis was on the processing and use of radar data and the preparations for ERS-1. Results were also presented from applications in botany, hydrology and geology. Status reports were given on data distribution, remote sensing in the developing countries and the Japanese MOS-1 satellite. For individual titles, see N93-22437 through N93-22449.

N93-22437# European Space Agency, Paris (France).

THE FIRST EUROPEAN REMOTE SENSING SATELLITE, ERS-1. A SUMMARY OF USEFUL LOAD, MISSION, GROUND SEGMENT, STANDARD PRODUCTS AND USER SERVICE

Joerg Gredel *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 9-17 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 11-20 Original language document was announced as N91-12993 (For primary document see N93-22436 08-43)

Avail: CASI HC A02/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The first ESA ERS-1 is expected to be brought into an approximately circular Sun synchronized orbit in Spring 1991. The active and passive sensors for its main purpose of oceanic and sea ice observations are outlined. Changes of orbit to suit the mission are given. A graphical representation of the ground segment for data reception and processing is given. The mission management and control center is at ESOC (Darmstadt, Germany) and the central facility at ESRIN (Frascati, Italy) is the main user interface. The composition of the worldwide network of sensor data ground stations is outlined. Processing and Archiving Facilities (PAF's) are being set up in England, France, Italy and Germany, F.R. Duties of the German ground segment, which include the German PAF and the Antarctic reception station, are given. The site of the Antarctic station is depicted, with the reception range for ERS-1 and the SAR (Synthetic Aperture Radar) strips of an orbit configuration with a three day repetition cycle. It is emphasized that NOAA AVHRR (Advanced Very High Resolution Radiometer) will be received here. A preliminary list of ERS-1 data and ESA products is presented. ESA

N93-22438# European Space Agency, Paris (France).

USE OF REMOTE SENSING AS PART OF THE TECHNICAL CO-OPERATION WITH DEVELOPING COUNTRIES

Reinhold Baeuerle *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 18-21 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdarenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 21-26 Original language document was announced as N91-12994 (For primary document see N93-22436 08-43)

Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The use of satellite remote sensing for GTZ (German association for technical cooperation) projects in cooperation with developing countries is described. The main application fields are hydrology, land utilization surveys, forestry, regional planning, integrated regional development in rural areas, erosion protection, cartography, and the struggle against desertification. Additional projects to establish and extend remote sensing institutions in various countries are described. Aspects related to the establishment of remote sensing institutions in developing countries are outlined: personnel availability, infrastructure provision, high quality equipment maintenance, and supply of consumables. Legal and financial considerations are mentioned. The particular development objectives mentioned are to ensure the supply of foodstuffs and the development of the rural areas while protecting the environment, particularly in terms of land utilization planning, afforestation, forestry activities and the prevention of erosion. ESA

N93-22439# European Space Agency, Paris (France).

EARTH SENSING DATA SERVICE

Dieter Gottschalk *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 22-23 Transl. into ENGLISH from Tagungsband: 6th Nutzerserinar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 27-30 Original language document was announced as N91-12995 (For primary document see N93-22436 08-43)

Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The Earth sensing Data Service (EDS) has established a field of operation whose main objective is to distribute image data from operational Earth observation satellites in association with processing and preparation of the data product to suit practical applications and active support for the use of the product. EDS is therefore associated with the concept of a remote sensing association developed with DLR, and establishes the conditions necessary for the DLR objectives of transferring the data distribution duties to industry. EDS represents a further step in the direction of making some satellite Earth observation activities into a commercial operation. Thus development has commenced in the application field (value adding companies). The organization of data distribution in the private sector is outlined. Experience shows that large scale use depends critically on the user being informed of the possibilities and having easy and rapid access to the data. The tasks of EDS were correspondingly defined and its operations will serve these objectives. ESA

N93-22440# European Space Agency, Paris (France).

GEOLOGICAL APPLICATIONS OF SPACE SAR DATA

Manfred F. Buchroithner *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 27-31 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 35-40 Original language document was announced as N91-12996 (For primary document see N93-22436 08-43)

Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The use of space SAR (Synthetic Aperture Radar) data for geological applications, particularly the possibility of exposures with variable angles of incidence and different frequencies and the geocoding technique of operational geometric product distortion removal, is discussed. Experience obtained with Seasat, SIR-A and SIR-B is to be used for SIR-C and ERS-1. The subdivisions of geocoding into ellipsoid and terrain corrections are described. The requirement for availability of radar orthographic images for high relief terrain work is discussed. The use of both geometrically uncorrected and geocoded images for analysis of geological lineaments is

discussed. The potential for the use of space SAR image data appears in both general geology and economic and technical geology: lithological and tectonic mapping, exploration of soil, gas, ore and industrial minerals and civil engineering roadway and site determination. So called secondary image products which, in addition to the geocoded images, also include stereo image pairs and multiparameter color combinations from them (and also perspective views) will make the usefulness of cosmic SAR data increasingly apparent in the future. ESA

N93-22441# European Space Agency, Paris (France).
GEOCODED PRODUCTS OF FUTURE RADAR SENSORS
Gunter Schreier *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 32-35 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 32-35 Original language document was announced as N91-12997 (For primary document see N93-22436 08-43)
Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Fundamental concepts of 'georeferencing' and 'geocoding' in remote sensing satellite image analysis are given, and the requirements for geometrical/mapping accuracy and high product throughput in an operational environment, in particular for the case of SAR (Synthetic Aperture Radar), are addressed. An example of the latter, the image distortions in undulating terrain due to the side view geometry, which makes it necessary to use a Digital Elevation Model (DEM) of high resolution for geometrical corrections, is addressed. In order to process DEM data, it must currently be corrected, archived and geometrically resampled; quality control of the products similarly makes control and inspection points necessary and these must also be digitally archived and processed in a corresponding manner; the finished geocoded products are oriented on topographical maps which are also archived for reference purposes. In order to deal with all this data operationally, data banks are set up for DEM's, control points and topographical maps and these banks are already filled with data. As an example, digital altitude models for the area of Germany, F.R., and topographical maps to a scale of 1:50,000 for the whole of Central Europe are available. For the actual geocoding, two groups of products which differ in their geometrical accuracy, as a function of the availability of reference data, are distinguished: in the case of a Geocoded Ellipsoid Corrected (GEC) product, the surface of the Earth is approximately represented by a locally modified ellipsoid; in the case of a Geocoded Terrain Corrected (GTC) product, the position of each pixel is recalculated, because of the terrain distortions in SAR, by means of a digital altitude model. ESA

N93-22442# European Space Agency, Paris (France).
MOS-1 Status Report
Juerg Lichtennegger *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 36-37 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 45-46 Original language document was announced as N91-12998 (For primary document see N93-22436 08-43)
Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Details of the payload of the Japanese Earth sensing satellite MOS-1 (Marine Observation Satellite) including the MSSR (Multispectral Self Scanning Radiometer), the VTIR (Visible and Thermal Infrared Radiometer), and the MSR (Microwave Scanning Radiometer), are given. Products being offered are currently individual; combined products from data from more than one sensor or several scenes per magnetic tapes are under development. One VTIR scene contains 4 minutes of orbit data and covers an area of 1500 by 1574 km. One MSR product consists of a complete exposure strip of one reception station and covers a maximum area of 5000 by 317 km. ESA

N93-22443# European Space Agency, Paris (France).
VEGETATION INDEX FOR EUROPE
Matthias Eckardt and Wolfgang Tonn *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 38-42 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 47-52 Original language document was announced as N91-12999 (For primary document see N93-22436 08-43)
Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The calculation of a Normalized Vegetation Index (NDVI) from NOAA AVHRR (Advanced Very High Resolution Radiometer) data using spectral channels 1 and 2 is reported. NOAA AVHRR data are useful for land surface properties of importance in global and mesoscale climatic models because, in contrast to LANDSAT Thematic Mapper data, they offer daily flyover. Production of global vegetation index maps on the basis of global area coverage data is discussed. The channel spectral ranges are given. Absorption capabilities of the leaf pigments and the influence of the atmosphere are discussed. A diagram showing the annual variation of the NDVI over Central Europe for 1989 is given. Different vegetation forms cannot be distinguished unambiguously from the normalized vegetation index alone; it only produced a limited measure of the leaf surface index and/or the absolute biomass; it is, however, almost directly proportional to the absorbed photosynthetically active radiation. ESA

N93-22444# European Space Agency, Paris (France).
WATER SURFACE TEMPERATURES FROM SATELLITE THERMAL IMAGES
Peter L. Lobemeier *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 43-47 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 53-58 Original language document was announced as N91-13000 (For primary document see N93-22436 08-43)
Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The preparation of area coverage data in water surface, wind and state of sea, by marine remote sensing, in order to produce and operate models of the oceanographic layers and sonar predictions, is reported. Weather satellites of the TIROS-N type routinely supply thermal images of the surface of the sea. The Planck radiation law determined the associated temperature for a black body from the radiation intensity in a wavelength band. Approximately 98 percent of the radiation measured in the 8.3 to 12.5 micron and is emitted by the surface of the water, i.e., water behaves approximately as a black body. Scatter on aerosols and absorption in the atmosphere reduce the radiation in the transmission path between the surface of the water and the satellite sensor. Water in the atmosphere (clouds) makes an additional contribution to the total radiation at the sensor. The measurement of the aerosol content of the air using lidar and determination of the temperature and humidity profile of the atmosphere using ratio probes are reported. In order to interpret thermal IR satellite pictures correctly, it is necessary to know the meteorological relationships in the area under investigation. Using exposures in the visible range, slick areas can be localized and these can be included in the interpretation of the spatial distribution of water surface temperature. ESA

N93-22445# European Space Agency, Paris (France).
DISTINGUISHING ICE THICKNESS FROM SEA ICE SURFACE SHAPE BY USING NOAA-AVHRR (NATIONAL OCEANIC AND ATMOSPHERE ADMINISTRATION ADVANCED VERY HIGH RESOLUTION RADIOMETER) AND SAR DATA
Christine Koenig *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 48-53 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 59-64 Original language document was announced as N91-13001 (For primary document see N93-22436 08-43)
Avail: CASI HC A02/MF A01; original German version available from

DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

NOAA AVHRR and SAR (Synthetic Aperture Radar) investigations, to establish an automatic classification method which would make it possible for ice formation services to recognize small scale ice structures and to undertake accurate geographical location of the sea, are reported. A few results sufficient to show that NOAA and active radar data complement one another in a profitable manner are described. Where NOAA records provided information on ice thicknesses and the moisture contents of the ice surfaces, ice fracture and ice compaction structures can be extracted from the radar scenes. The extent to which superimposing the two types of sensors provides an additional source of information is currently being investigated. It is, however, clear that the combined information makes it possible to distinguish pressure ridges from ship tracks. ESA

N93-22446# European Space Agency, Paris (France).

INVESTIGATIONS INTO THE DYNAMICS OF SEA ICE IN THE EAST GREENLAND SEA REGION IN MAY 1988, USING NOAA-AVHRR DATA

Stefan W. Dech *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 54-59 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 65-72 Original language document was announced as N91-13002 (For primary document see N93-22436 08-43)

Avail: CASI HC A02/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The use of NOAA AVHRR (Advanced Very High Resolution Radiometer) data to analyze the structure causing sea ice movements in the East Greenland Sea is reported. The movements of the sea ice were interactively extracted both by means of a statistical cross correlation method and by means of individual point tracking from a respective AVHRR channel 1 image pair. They were recorded in the form of ice flow displacement vectors. The satellite data had been previously calibrated and corrected for Sun level. From the vector fields obtained in this way, it is possible to determine the drift relationships and velocities of the drift ice regions in the area under investigation and to draw other important conclusions with respect to diverging or converging ice floes. Additional data was acquired in order to analyze the parameters influencing the ice drift. As an example, 173 aeriel photographs were produced along the edge of the ice in order to determine the ice surface morphology and two thematic mapper scenes were multispectrally processed near the solid ice region. In addition, three anchoring data sets were used to validate the flow and velocity of the East Greenland current. Meteorological information on wind direction and velocity on 500, 700, 850 and 1000 hPa and the pressure and the temperature distribution were taken from the analysis of the European Center for Medium Range Weather Forecast (ECMWF). Results produced from the analysis are given. Examples of images given are described.

ESA

N93-22447# European Space Agency, Paris (France).

THE USE OF REMOTE SENSING DATA IN A STATISTICAL GROUND UTILIZATION INFORMATION SYSTEM

Klaus Niemz *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 60-64 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 73-78 Original language document was announced as N91-13003 (For primary document see N93-22436 08-43)

Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The STABIS data are collected and updated to suit the most varied types of user. In addition to the aerial photographs already evaluated on a test basis, the intention is to use more and more satellite images because of their known advantages in terms of interpretation. The main advantages of current satellite images are detailed, and the analysis of user requirements, the matching of the content of the satellite data, mathematical/statistical processing, and the interpretation to the results of this analysis, are reported. Conditions to be met by satellite images from the statistical point of view are discussed. Results of data preprocessing and associated results of classification of individual types of use are shown. Requirements for the STABIS are not yet realized. Whereas the mathematical/statistical methods such as the maximum likelihood method are proved, the classification procedure is still problematical. The accuracy of classification of satellite data (spectral information over different materials) for a statistical ground utilization system can only be assessed by means of a logical and feasible procedure. Whereas data interpretations are necessary for classification, interpretation for nonhomogeneous areas represents the only possibility of rapidly fulfilling the task of producing a statistical ground utilization system. The spectral classification (supplemented by pure interpretation) will make it possible to fill most of the STABIS catalog from remote sensing data and to keep it up to date. ESA

N93-22448# European Space Agency, Paris (France).

CLASSIFICATION OF TM DATA AS A CONTRIBUTION TO REMOTE SENSING FOR A HYDROLOGICAL RUN-OFF MODEL

Stefan Kleeschulte *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 65-69 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 79-84 Original language document was announced as N91-13004 (For primary document see N93-22436 08-43)

Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Work on using TM (Thematic Mapper) remote sensing data in hydrology is reported. Land use mapping using TM data using subclasses of water, agricultural areas, grassland, forested areas, and urban areas, is discussed. The TR-20 precipitation/runoff model, which uses land use information, a digital terrain model, ground data, and precipitation data, is described. Results of the runoff simulation, are shown. The measured and calculated cases agree very well with respect to two most important high water characteristics, the peak runoff and the time when the peak flow occurs. Two forest damage scenarios produced using the data for this event are discussed. An increase in the high water danger when the average proportion of the forest damaged in the Rhineland Palatinate dies and is replaced by grass vegetation (50 percent damage) is shown. The '100 damage' characteristic is a scenario for the case where the whole of the forest in the catchment area dies. The consequences of forest death and other negative evironmental changes (for examples surface sealing) are an increase in the high water danger because the peak occurs earlier and the peak flow is higher. However, the indirect consequences, for example due to decreased infiltration, are also of great importance to the balance of nature on the long term. For this reason, simulation models are of great importance in water economy planning. For this purpose, however, such models require further development so that the data, which is already available in detail in terms of area (for example precipitation measurements with radar), can be also processed in detail in terms of area (by pixel).

ESA

N93-22449# European Space Agency, Paris (France).

SATELLITE IMAGE AND REFERENCE DATA INVESTIGATIONS FOR EXPLORATION PURPOSES

Dieter Schlichter *In its* Proceedings of Sixth User Seminar of the German Remote Sensing Data Centre of the German Aerospace Research Establishment (DLR) Aug. 1992 p 70-74 Transl. into ENGLISH from Tagungsband: 6th Nutzerseminar des Deutschen Fernerkundungsdatenzentrums der DLR (Oberpfaffenhofen, Germany, DLR), Mar. 1990 p 85-90 Original language document was announced as N91-13005 (For primary document see N93-22436 08-43)

Avail: CASI HC A01/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Investigation on methods for the exploration of concealed uranium deposits, using digital processing of remote sensing and other data, is reported. The principal objective was a substantially reproducible and rapid remote sensing method for mapping promising ore structures in the crystalline primary rock formation. A large part of the TM (Thematic Mapper) image processing involved texture investigations in addition to other processes. Therefore, an image processing law was sought for texture investigation

with those areas from which conclusions could be drawn about lithology and geology presented together or at least in such a manner that they can be clearly associated. A very promising law for this purpose is provided by bit plane division or manipulation. In this, a half tone image is divided into its bit planes which are then individually processed and subsequently transformed back, if necessary in a new order. Interesting results are discussed. ESA

N93-22454*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science and Research Lab. of Electronics.

THIRD STOKES PARAMETER EMISSION FROM A PERIODIC WATER SURFACE

J. T. Johnson, J. A. Kong, R. T. Shin, D. H. Staelin, K. ONeill (Army Cold Regions Research and Engineering Lab., Hanover, NH.), and A. Lohanick (Army Cold Regions Research and Engineering Lab., Hanover, NH.) 1991 35 p Sponsored in part by NSF

(Contract NAGw-1617; N00014-92-J-1616)

(NASA-CR-192334; NAS 1.26:192334) Avail: CASI HC A03/MF A01

An experiment in which the third Stokes parameter thermal emission from a periodic water surface was measured is documented. This parameter is shown to be related to the direction of periodicity of the periodic surface and to approach brightnesses of up to 30 K at X band for the surface used in the experiment. The surface actually analyzed was a 'two-layer' periodic surface; the theory of thermal emission from such a surface is derived and the theoretical results are found to be in good agreement with the experimental measurements. These results further the idea of using the third Stokes parameter emission as an indicator of wind direction over the ocean. Author

N93-22461# European Space Agency, Paris (France).

THEMATIC MAPPER LAND USE CLASSIFICATION AS A REMOTE SENSING CONTRIBUTION FOR HYDROLOGIC RUNOFF PREDICTION MODEL [THEMATIC-MAPPER-LANDNUTZUNGS-KLASSIFIKATION ALS BEITRAG DER FERNERKUNDUNG FUER EIN HYDROLOGISCHES ABFLUSSVORHERSAGEMODELL]

Stefan Kleeschulte (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany.) Sep. 1992 129 p Transl. into ENGLISH of Thematic-Mapper-Landnutzungs-Klassifikation als Beitrag der Fernerkundung fuer ein Hydrologisches Abflussvorhersagemodell (Oberpfaffenhofen, Germany, DLR), Mar. 1990 Original language document was announced as N91-12149

(ESA-TT-1238; DLR-FB-90-16; ETN-93-93514) Avail: CASI HC A07/MF A02; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The use of remote sensing data covering large areas to elucidate spatially complex processes in hydrology is addressed. In particular, LANDSAT data is used to make an attempt to predict the runoff process in a small drainage area (200 sq km), using the relationship between land use and runoff. This is done by comparing measured hydrographs with those calculated for known precipitation events using the model. The LANDSAT system is reviewed, the Thematic Mapper mode of operation is described, and the study area and climatic conditions are presented. Digital image processing involves classification procedures, geometrical rectification, and a digital terrain model. In a further step, scenarios which represent possible future developments in the study area are elaborated. These scenarios are concerned with changes in runoff due to forest damage, the taking of agricultural lands out of use and urbanization effects. ESA

N93-22699*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

CALIBRATION, NAVIGATION, AND REGISTRATION OF MAMS DATA FOR FIFE

G. J. Jedlovec and R. J. Atkinson (General Electric Co., Huntsville, AL.) Feb. 1993 56 p

(NASA-CR-108397; NAS 1.15:108397) Avail: CASI HC A04/MF A01

The International Satellite Land Surface Climatology Project (ISLSCP) was conducted to study the interaction of the atmosphere with the land surface and the research problems associated with the interpretation of satellite data over the Earth's land surface. The experimental objectives of the First ISLSCP Field Experiment (FIFE) were the simultaneous acquisition of satellite, atmospheric, and surface data and to use these data to understand the processes controlling energy/mass exchange at the surface. The experiment site is a 15 x 15 km area southeast of Manhattan, Kansas, intersected by Interstate 70 and Kansas highway 177. The Konza Prairie portion is 5 x 5 km and is a controlled experiment site consisting primarily of native tall grass prairie vegetation. The remainder of the site is grazing and farm land with trees along creek beds that are scattered over the area. Airborne multispectral imagery from the Multispectral Atmospheric Mapping Sensor (MAMS) was collected over this region on two days during Intensive Field Campaign-1 (1FC-1) to study the time and space variability of remotely-sensed geophysical parameters. These datasets consist of multiple overflights covering about a 60-min period during late morning on June 4, 1987 and shortly after dark on the following day. Image data from each overpass were calibrated and Earth located with respect to each other using aircraft inertial navigation system parameters and ground control points. These were the first MAMS flights made with 10-bit thermal data. Author

N93-23106# Beleidscommissie Remote Sensing, Delft (Netherlands).

INVESTIGATION OF THE APPLICABILITY OF REMOTE SENSING TECHNIQUES FOR ECOLOGICAL WATER QUALITY EVALUATION [ONDERZOEK NAAR DE TOEPASSINGSMOGELIJKHEDEN VAN ENKELE REMOTE SENSING TECHNIEKEN TEN BEHOEVE VAN ECOLOGISCHE WATERKWALITEITSBEOORDELING]

Feb. 1992 59 p In DUTCH Prepared in cooperation with Raadgevende Ingenieurs Witteveen en Bos, Delft, Netherlands

(BCRS-91-37; ISBN-90-5411-021-X; ETN-93-91885) Avail: CASI HC A04/MF A01

The applicability of two remote sensing techniques for the ecological evaluation of surface waters was investigated with a view to the stimulation of remote sensing in the Netherlands. The investigation of water quality using remote sensing is complex. Most techniques are not suited due to the location of spectral bands and the required radiometric sensitivity. The effect of atmospherics and seasons on the reflection is large and makes a generally valid interpretation difficult. Therefore, the determination of the ecological water quality using remote sensing is only a very limited success. ESA

N93-23213 Ohio State Univ., Columbus.

IMAGE INTERPRETATION FOR LANDFORMS USING EXPERT SYSTEMS AND TERRAIN ANALYSIS Ph.D. Thesis

Abdullah Mohammed Al-Garni 1992 188 p

Avail: Univ. Microfilms Order No. DA9238119

Most current research in digital photogrammetry and computer vision concentrates on the early vision process: little research has been done on the late vision process. The late vision process in image interpretation contains descriptive knowledge and heuristic information which requires artificial intelligence (AI) in order for it to be modeled. This dissertation has introduced expert systems, as AI tools, and terrain analysis to the late vision process. This goal has been achieved by selecting and theorizing landforms as features for image interpretation. These features present a wide spectrum of knowledge that can furnish a good foundation for image interpretation processes. In this dissertation an EXpert system for LANdform interpretation using Terrain analysis (EXLANT) was developed. EXLANT can interpret the major landforms on earth. The system contains sample military and civilian consultations regarding site analysis and development. A learning mechanism was developed to accommodate necessary improvement for the data base due to the rapidly advancing and dynamically changing technology and knowledge. Many interface facilities and menu-driven screens were developed in the system to aid the users. Finally, the system has been tested and verified to be working properly.

Dissert. Abstr.

N93-23239* National Aeronautics and Space Administration, Washington, DC.

BIBLIOGRAPHY OF GLOBAL CHANGE, 1992

Feb. 1993 175 p

(NASA-SP-7102; NAS 1.21:7102) Avail: CASI HC A08/MF A02

This bibliography lists 585 reports, articles, and other documents introduced in the NASA Scientific and Technical Information Database in 1992. The areas covered include global change, decision making, earth observation (from space), forecasting, global warming, policies, and trends.

Derived from text

N93-23254# National Telecommunications and Information Administration, Annapolis, MD.
NTIA TERRAIN DATA BASE SYSTEM DOCUMENTATION (PROGRAM DUMPTERS, EXTRACT AND TERND). VERSION 4.0, OCTOBER 1992
P. Roosa, C. Winkler, W. Frazier, and E. Calhoon Oct. 1992 15 p
(PB93-108330) Avail: CASI HC A03/MF A01

The document describes the contents and layout of the Microcomputer Spectrum Analysis Models (MSAM) Terrain Topographic 30-second data base. The geographic scope of the data base is the U.S. (less Alaska), Hawaii, Puerto Rico, plus international including Carribean and border areas of Canada and Mexico. Utility programs, TERND, DUMPTER, and EXTRACT are described, plus the FORTRAN source code subroutines which directly access the data base. Author

N93-23257# Florida Univ., Gainesville. Dept. of Civil Engineering.
EXPANDED GEODETIC CONTROL ALONG THE PRIMARY ROAD SYSTEM BY USE OF SATELLITE SURVEYING TECHNOLOGY Final Report, Sep. 1990 - Dec. 1991
Bon Dewitt, Scot E. Smith, and Larry V. Stanislawski Oct. 1991 87 p
Sponsored by Florida State DOT, and FHA, Tallahassee
(PB93-127090; FL/DOT/RMC-0397-2960) Avail: CASI HC A05/MF A01

An investigation was conducted to develop guidelines for performing and analyzing network adjustments of baseline measurements collected with Global Positioning System relative positioning techniques. Four second order class 1 geodetic control networks were established along transportation corridors according to the standards and specifications described by the Federal Geodetic Control Committee. Four Trimble 4000SX receivers were used to collect the data. Each of the four networks was adjusted independently on two different datums, NAD27 and NAD83. The results of the NAD83 adjustments showed station error ellipses that have semi-major axes ranging between 0.008 m and 0.090 m at the 95 percent level of confidence, and baseline precisions that range between 0.126 PPM and 13.096 PPM. The NAD27 adjustments showed error ellipses having semi-major axes that range between 0.023 m and 0.935 m at the 95 percent level of confidence and baseline precisions ranging between 1.315 PPM and 26.172 PPM. Some guidelines and recommendations for performing weighted least squares adjustments of GPS networks are provided. Author

N93-23278# National Oceanic and Atmospheric Administration, Washington, DC.
USE OF COASTAL ZONE COLOR SCANNER IMAGERY TO IDENTIFY NEARSHORE OCEAN AREAS AFFECTED BY LAND-BASED POLLUTANTS Final Report
T. F. LaPointe and D. J. Basta Jan. 1981 29 p
(PB93-136604) Avail: CASI HC A03/MF A01

The purpose of the analysis was to use remotely sensed satellite imagery to determine the spatial boundaries of nearshore areas or zones likely to be affected by pollutants from land-based sources, so that data collected on the presence or absence of living marine resources could be combined with information on land-based pollutant discharges in a preliminary relative assessment of potential risk. Ocean zones of impact related to East Coast estuaries and embayments were approximated using reflectance patterns from data transmitted from the Coastal Zone Color Scanner (CZCS) instrument mounted on the NASA Nimbus-7 satellite. Data were transformed from numerical measures of radiance to photographic images suitable for identifying and mapping ocean impact zones through a simple enhancement technique. GRA

N93-23352 Pennsylvania State Univ., University Park.
GROUND-BASED MICROWAVE RADIOMETRIC REMOTE SENSING OF THE TROPICAL ATMOSPHERE Ph.D. Thesis
Yong Han 1992 188 p
Avail: Univ. Microfilms Order No. DA9236836

A partially developed 9-channel ground-based microwave radiometer for the Department of Meteorology at Penn State was completed and tested. Complementary units were added, corrections to both hardware and software were made, and system software was corrected and upgraded. Measurements from this radiometer were used to infer tropospheric temperature, water vapor and cloud liquid water. The various weighting functions at each of the 9 channels were calculated and analyzed to estimate the sensitivities of the brightness temperatures to the desired atmospheric variables. The mathematical inversion problem, in a linear form, was viewed in terms of the theory of linear algebra. Several methods for solving the inversion problem were reviewed. Radiometric observations were conducted during the 1990 Tropical Cyclone Motion Experiment. The radiometer was installed on the island of Saipan in a tropical region. During this experiment, the radiometer was calibrated by using tipping curve and radiosonde data as well as measurements of the radiation from a blackbody absorber. A linear statistical method was first applied for the data inversion. The inversion coefficients in the equation were obtained using a large number of radiosonde profiles from Guam and a radiative transfer model. Retrievals were compared with those from local, Saipan, radiosonde measurements. Water vapor profiles, integrated water vapor, and integrated liquid water were retrieved successfully. For temperature profile retrievals, however, it was shown that the radiometric measurements with experimental noises added no more profile information to the inversion than that which was available from a climatological mean. Although successful retrievals of the geopotential heights were made, it was shown that they were determined mainly by the surface pressure measurements. The reasons why the radiometer did not contribute to the retrievals of temperature profiles and geopotential heights were discussed. A method was developed to derive the integrated water vapor and liquid water from combined radiometer and ceilometer measurements. Under certain assumptions, the cloud absorption coefficients and mean radiating temperature, used in the physical or statistical inversion equation, were determined from the measurements. It was shown that significant improvement on radiometric measurements of the integrated liquid water can be gained with this method. Dissert. Abstr.

N93-23461# New Mexico Inst. of Mining and Technology, Socorro.
REMOTE SENSING OF PRECIPITATION AND ELECTRIFICATION WITH A DUAL-POLARIZATION, COHERENT, WIDEBAND RADAR SYSTEM Annual Report No. 3, 15 Jul. 1991 - 14 Jul. 1992
Paul R. Krehbiel and Grant Gray 17 Sep. 1992 8 p
(Grant AF-AFOSR-0450-89)
(AD-A259834; AFOSR-92-1001TR) Avail: CASI HC A02/MF A01

The New Mexico Tech Wideband/Coherent Radar was shipped by rail to Kennedy Space Center on 17 July 1991. A problem in the transmitter cooling system delayed full operation until mid August. Electrification signatures were first observed on 15 September and numerous cases were documented between then and tear-down on 6 October. In addition, several cases of coordinated dual-Doppler and tomographic data were acquired in conjunction with the NCAR CP2 radar. Preliminary results have been presented in papers and conferences. After its return to New Mexico, several upgrades were made to the transmitter to increase reliability. GRA

N93-23507# European Space Agency, Paris (France).
ENVIRONMENT OBSERVATION AND CLIMATE MODELLING THROUGH INTERNATIONAL SPACE PROJECTS. NAVIGATION AND MOBILE COMMUNICATIONS. IMAGE PROCESSING, GIS, AND SPACE-ASSISTED MAPPING
T. Duc Guyenne, ed. and James J. Hunt, ed. Jul. 1992 428 p In ENGLISH and FRENCH Conference held in Munich, Germany, 30 Mar. - 4 Apr. 1992; sponsored by EEC, ESA, Deutsche Agentur fuer Raumfahtangelegenheiten, and the European Association for the International Space Year
(ESA-ISY-2; ETN-93-93505) Copyright Avail: CASI HC A19/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The European International Space Year conference was held with the specific theme of the practical use of space derived information for environmental research, environmental monitoring, and resource management. This main theme, 'Mission to Planet Earth,' was maintained, but it was recognized that other fields needed to be equally addressed to provide a balanced view on space activities. Space sciences, space navigation and communications, and manned space activities were also represented. The present volume consists of papers addressing the following issues: space based systems for navigation and mobile communications; image processing, geographic information systems, and space assisted mapping. For individual titles, see N93-23508 through N93-23586.

N93-23508# Federal Maritime and Hydrographic Agency (Germany).
MARITIME SATELLITE COMMUNICATION AND NAVIGATION c32

Peter Ehlers *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 5-8 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The contribution of satellite services to improving maritime safety, covering navigation as well as safety and distress communication, is discussed. The availability and accessibility of these services must be ascertained through international agreements. Satellite services will play an essential role for the electronic sea chart display. International carriage requirements and performance standards are necessary for the relevant equipment on board ships. New generic mobile satellite services will also be of relevance for maritime communication. As far as safety and distress communication is concerned, government agreements are necessary.
ESA

N93-23509# Department of Transportation, Washington, DC.
THE ROLE OF GPS IN A FUTURE RADIONAVIGATION MIX: TRENDS IN THE 1992 US FEDERAL RADIONAVIGATION PLAN **c04**
Heywood O. Shirer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 9-14 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

An overview of the role of GPS (Global Positioning System) in the future radio navigation mix is given and changes that might be expected in the 1992 U.S. Federal Radio navigation Plan (FRP) are examined. The GPS will have a significant impact on other radio navigation systems and will have a wide range of applications in aviation, marine, land, and non-navigation uses. The GPS SPS (Standard Positioning Service) was offered to ICAO (International Civil Aviation Organization) to form a practical starting point to begin acquiring the operational experience necessary for the development of a Global Navigation Satellite System (GNSS). Work has now begun to develop the policies and plans to be published in the 1992 FRP for GPS and other Federally provided radio navigation systems.
ESA

N93-23510# Munich Reinsurance Co. (Germany).
INSURANCE COVER FOR SPACE VENTURES **c81**
Ernst Steilen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 15-18 (For primary document see N93-23507 08-43)
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A discussion on insurance coverage for space ventures covering market development, types of insurance coverage, specific aspects of space insurance, and market experience, is presented. Space risks are seen as generally insurable if a long term oriented underwriting philosophy and a worldwide portfolio are taken into account. Further prerequisites are as follows: careful and professional risk assessment; a qualified staff; coverage concepts that are specifically tailored to each particular risk; and appropriate premiums, including adequate safety margins and loadings, which enable the insurer to make proper allowances for fluctuations in loss experience.
ESA

N93-23511# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
COLLECTION AND DISTRIBUTION OF ECOLOGICAL DATA BY SATELLITE: CDEDS **c45**
F. Gampe, K.-P. Graf (Elektronik-System G.m.b.H., Munich, Germany.), and G. Solari *In its* Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 19-23 (For primary document see N93-23507 08-43)
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An ESA/ESTEC study being performed to assess the conditions under which services for ecological data could develop, and to what extent, is reported. Collection and distribution of ecological data is seen as a key item in environmental monitoring. Many public and private bodies and the public itself are interested in objective and reliable information about the state of the environment. Satellite communications can play a significant role for the development of ecological networks and information systems, but their benefits are not well known by the common users.
ESA

N93-23512# Elektronik-System G.m.b.H., Munich (Germany).
COLLECTION AND DISTRIBUTION OF ECOLOGICAL DATA BY SATELLITE PILOT PROJECTS AS DEMONSTRATION OF THE CONCEPT **c45**
K.-P. Graf and F. Gampe (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 25-31 (For primary document see N93-23507 08-43)
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Several proposals for pilot projects to demonstrate the benefits and usefulness of online collection and distribution of in situ ecological data by satellite and to contribute to the promotion of satellite communications in this sphere are presented. The pilot project proposals were elaborated in the frame of the ESA study 'Collection and Distribution of Ecological Data by Satellite' as proof of the concepts developed during this study. In particular, the following are reported: an agricultural information system; an animal tracking system; a radiation and smog early warning system; and a river and coastal water monitoring system.
ESA

N93-23513# Royal Geographical Society, London (England). Royal Inst. of Navigation.
A EUROPEAN RADIONAVIGATION PLAN? **c04**
D. W. Broughton *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 33-35 (For primary document see N93-23507 08-43)
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A discussion on the possibility of a radio navigation plan for Europe is presented. Radio aids to navigation are indispensable for the safe and efficient transport of people and goods. It is unfortunate that the past 50 years have seen the uncoordinated development of such aid in Europe. This could be overcome by the adoption of a radio navigation plan similar to the U.S. Federal Radionavigation Plan which is jointly promulgated at two yearly intervals by the Departments of Defense and Transportation. The International Association of Institutes of Navigation has prompted the Council of the European Community to institute a European plan, and this is about to get under way. Such a plan needs to recognize plans in adjacent areas and indeed the sum of such plans could lead to a worldwide radio navigation plan.
ESA

N93-23514# Lufthansa German Airlines, Frankfurt (Germany).
AIRLINE APPLICATIONS IN AIR-/GROUND COMMUNICATION USING ADVANCED TECHNOLOGIES **c32**
Heinrich Mensen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 37-38 (For primary document see N93-23507 08-43)
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The involvement of the German airline Lufthansa in the further development of air/ground communication is outlined. Air/ground communication is defined as the overall complex of data and voice communication meeting the specific requirements of internal airline affairs, passenger services, and air traffic control. In particular, applications in Aeronautical Operational Control (AOC), Aeronautical Administrative Communications (AAC), ATS (Air Traffic Services), and APC (Aeronautical Passenger Communications), are described.
ESA

N93-23515# Telesat Canada, Ottawa (Ontario).
THE CANADIAN MOBILE SATELLITE SYSTEM **c32**
Elemer Bertenyi *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile

Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 39-43 (For primary document see N93-23507 08-43)
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Plans to upgrade Canadian mobile data services by introducing a full, two way mobile voice and data service, using a large geostationary satellite which is scheduled to be launched in 1994, are reported. This Mobile Satellite (MSAT) will offer customers the ability to communicate, using mobile or transportable terminals, from the most remote parts of the continent, to any other point within North America, and indeed the whole world. Currently planned MSAT services are reviewed, the main features of the overall system are outlined, and the configuration and key performance parameters of the MSAT satellite are presented. The communications subsystem is detailed, and a summary of the spacecraft service module is given. ESA

N93-23516# Rhode and Schwartz G.m.b.H., Munich (Germany).
FULLY AUTOMATIC TRANSMISSION OF INFORMATION VIA HF AND COMPARISON TO SATELLITE TRANSMISSION **c32**
P. Iselt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 45-50 (For primary document see N93-23507 08-43)
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For various applications, in particular in long range communications, both HF radio communication and SATCOM systems can be alternatively used irrespective of the technical infrastructure. In the past, HF radio as compared to SATCOM needed an experienced operator to achieve satisfactory results. Modern HF systems enable fully automatic and data protected transmission with a notable transfer rate of 2.4 kbit/s in the 3 kHz channel. In conjunction with an office communication system with appropriate message handling and control software, all data sources and sinks like telefax machines, data terminals, videotex etc., can be connected to different optimized communication systems, including HF system. The result is a cost optimized and redundant multimedia concept which can be custom configured to all needs. ESA

N93-23517# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Communications Technology Inst.
LAND MOBILE SATELLITE COMMUNICATIONS SYSTEMS AND SERVICES **c32**
E. Lutz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 51-55 (For primary document see N93-23507 08-43)
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An overview of existing and planned land mobile satellite communications systems and services is given. Operational and planned global systems such as Inmarsat, Iridium, and Globalstar, are highlighted, and the main technical details are listed. European and U.S. concepts are discussed. Applications for land mobile satellite communications are addressed, such as fleet management and global personal communications. The main technological challenges which are important for the future development of mobile communications, such as efficient use of spectrum, use of higher frequency bands, processing satellites with multiple beams, and suitable satellite orbits, are identified. ESA

N93-23518# Air Navigation Technical Service, Paris (France).
THE FUTURE ROLE OF SATELLITE COMMUNICATIONS IN AN IMPROVED AIR TRAFFIC MANAGEMENT **c32**
Patrice Gauthier (Service Technique de la Navigation Aerienne, Paris, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 57-60 (For primary document see N93-23507 08-43)
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The need for air to ground communication in Air Traffic Control (ATC) is discussed and a summary on the birth of aeronautical satellite communication is given. The standardization of an aeronautical mobile communications service by the International Civil Aviation Organization is reported. The feasibility analysis of satellite communications for ATC carried out by the French civil aviation is described. This 'South Pacific Trial' is regarded as a first step towards a full operational implementation. ESA

N93-23519# Beukers Technologies, Inc., Vero Beach, FL.
FINANCIAL ALTERNATIVES FOR GLOBAL SATELLITE NAVIGATION **c04**
John M. Beukers *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 61-66 (For primary document see N93-23507 08-43)
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Military programs within the U.S. and the former U.S.S.R. were responsible for providing the technology and hardware for gobal satellite navigation. The Global Positioning System (GPS) from the U.S. is nearing operational status and is demonstrating the potential for gobal navigation and position location. Without radical change, the policies and structures of the institutions that are creating these systems are seen to be incompatible with the requirements and obligations of the international community. The financial impact of redirecting satellite navigation technology for civil use is explored. Alternatives to a single country providing satellite system financing and operation are discussed. A proposal for funding a global system is presented along with an organization that involves the special agencies of the United Nations. ESA

N93-23520# International Maritime Satellite Organization, London (England).
MOBILE SATELLITE COMMUNICATIONS IN THE 1990'S **c32**
Jai Singh *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 69-73 (For primary document see N93-23507 08-43)
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The evolution of Inmarsat global services from a single market and single service of the 1980's to all of the key mobile markets and a wide range of new terminals and services in the 1990's is described. An overview of existing mobile satellite services, as well as new services under implementation for introduction in the near and longer term, including a handheld satellite phone (Inmarsat-P), is provided. The initiative taken by Inmarsat in the integration of its global mobile satellite services with global navigation capability derived from GPS (Global Positioning System) and the GLONASS (Russian GPS) navigation satellite systems and the provision of an international civil overlay for GPS/GLONASS integrity and augmentation is highlighted. To complete the overview of the development of mobile satellite services in the 1990's, the known national and regional mobile satellite system plans and the various recent proposals for both orbiting and geostationary satellite systems for proving handheld satellite phone and/or data messaging services are described. ESA

N93-23521# Italspazio, Rome (Italy).
PERSONAL COMMUNICATIONS SATELLITE SERVICE SYSTEM **c32**
L. Caporicci, S. DiGirolamo, M. Luongo, and C. Soddu *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 75-80 (For primary document see N93-23507 08-43)
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The main features of the Personal Communications System (PCS) are outlined. The PCS is composed of the following: a constellation of Low Earth Orbiting (LEO) satellites; and a ground segment made of a variety of user terminals, the gateway stations, the network management, and satellite control centers. A general overview of the system is provided, together with the definition of a satellite constellation suitable for PCS services. The adoption of LEO satellites sensibly reduces the power requirement of user terminals and allows users to share the system capacity among a large number of spacecraft. Results of a comparative analysis of access modes is presented together with the expected spacecraft complexity, which

derives by the alternative adoption of two types of onboard antennas, with 7 and 19 spot beams. An overall dimensioning of the payload and general outline of the spacecraft are given. ESA

N93-23522# Racal Survey Ltd., London (England).
SKYFIX: A BETTER POSITION THROUGH THE USE OF INMARSAT AND GPS **c04**
G. A. H. Mack *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 81-86 (For primary document see N93-23507 08-43)
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SkyFix is a satellite based DGPS (Differential Global Positioning System) service which uses the Inmarsat Marine Communications System as the datalink. SkyFix began operation in Aug. 1990, and its coverage is continuing to expand. Already SkyFix serves all the major offshore hydrocarbon exploration areas. The complementary application of two satellite systems and the synergy between them are described. The considerable infrastructure that is required for a comprehensive and professional DGPS system is discussed, and the gains in positioning service quality which can be achieved are demonstrated. ESA

N93-23523# Technische Univ., Brunswick (Germany). Inst. of Flight Guidance and Control.
PRECISE FLIGHT NAVIGATION BY INTEGRATION OF GLOBAL POSITIONING SYSTEM AND INERTIAL MEASUREMENT UNITS **c04**
Stefan Vieweg *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 87-92 (For primary document see N93-23507 08-43)
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Realtime Differential GPS (Global Positioning System) offers precise positioning capabilities. This can be achieved by combination of code and phase measurements with transmitted correction terms from a ground reference via link to the moving receiver e.g., in an aircraft. Although tight ICAO (International Civil Aviation Organization) limits for precision approaches or taxi guidance can be met, this system needs a complement to compensate insufficiencies, for example in dynamic maneuvers or total failure of position information due to satellite masking. Using International Measurement Units (IMU) with good dynamic characteristics but longterm drift as a result of misalignment, accelerometer and gyro errors, Kalman filter techniques are used to predict and eliminate these errors. Loss of GPS position due to jamming, satellite shadowing dynamic influences leads to a decreasing filter accuracy, if the GPS position is taken as reference (measurement vector) for the Kalman filter. Therefore a filter concept which is sustained by uncorrelated range and range rate measurements is discussed. Several investigations by means of simulation and flight tests show that the strategy chosen is able to perform precise position and attitude information. Even under dynamic environment with separated satellite masking an accuracy to meet the tight limits for precision approaches can be fulfilled. ESA

N93-23524# Niedersaechsisches Landesverwaltungsamt, Hanover (Germany). Abt. Landesvermessung.
A PERMANENT NEAR-ONLINE HIGH PRECISION POSITIONING SERVICE (HPPS) WITH GPS **c04**
Wolfgang Augath *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 93-95 (For primary document see N93-23507 08-43)
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The establishment and maintenance of nets of control points is a main task of the European Survey Agencies. For years DGPS (Differential Global Positioning System) has been used as an economic and precise method of measurement in this field. The problems with traditional nets of control points are described especially from the economic point of view. A proposal for a DGPS based High Precision Permanent Positioning Service (HPPS) on a +/- 1 cm level alternative to traditional control networks is given. The principle of a HPPS, open questions and the state of realization in northern Germany are described. The development of HPPS is supported by the German Space Agency. ESA

N93-23525# Centre d'Etudes de la Navigation Aerienne, Toulouse (France).
OSI APPLIED TO AERONAUTICAL SATELLITE MOBILE COMMUNICATIONS IN EURATN **c32**
Franck Monteil *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 97-102 (For primary document see N93-23507 08-43)
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The future Aeronautical Telecommunication Network ATN being standardized by ICAO (International Civil Aviation Organization) and application of OSI (Open Systems Interconnection) are described. The concepts developed by paper work have reached such a maturity that a validation step is now essential in parallel with futher ATN specification activity. This validation requires the development of an experimental ATN. This is the aim of the EURATN project. The Satcom satellite subnetwork will be part of this experimental ATN. The EURATN project will provide an experimental ATN, both for the validation aspects mentioned above and for ATM (Air Traffic Management) enhancement trials. Such experimental activities will be performed after EURATN completion, possibly in the frame of a EURATN 2 project. ESA

N93-23526# Eutelsat, Paris (France).
EUTELTRACS: THE EUROPEAN LAND MOBILE SATELLITE SERVICE **c32**
Jean-Noel Colcy, Rafael Steinhaeuser, and Kimberly Mock (Alcatel Qualcomm, Nanterre, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 103-108 (For primary document see N93-23507 08-43)
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EUTELTRACS is Europe's first commercially operated land mobile satellite service. EUTELTRACS provides an integrated message exchange and position reporting service for the European transportation industry with the aim of increasing cost effectiveness, radically improving efficiency and security and enhancing business flexibility. The architecture of the system is described, outlining the accuracy of the position determination, and an overview of the commercial deployment of EUTELTRACS is given. ESA

N93-23527# ANT Nachrichtentechnik, Backnang (Germany).
GLOBAL EARTH OBSERVATION USING MODERN COMMUNICATIONS SATELLITE TECHNIQUES **c32**
E. Loecherbach and G. Eckhardt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 111-116 (For primary document see N93-23507 08-43)
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The various properties of geostationary and low Earth orbiting satellites are discussed. Main emphasis is given to satellite interconnection techniques, due to the importance of Interorbit and Intersatellite Links (IOL and ISL) in a global and efficient Earth observation satellite system. Conventional microwave as well as modern optical techniques are possible candidates for these links. In this frame, a High Power Diode Transmitter (HPDT) is presented. As an outlook to a future worldwide communication scenario the integration of Earth observation satellites in an information satellite (Infosat) system is raised. ESA

N93-23528# Technische Univ., Munich (Germany). Inst. fuer Landtechnik.
SATELLITE NAVIGATION IN AGRICULTURE **c04**
H. Auernhammer and K. Wild *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 117-120 (For primary document see N93-23507

08-43)
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Change in agriculture in the 1990s is discussed. Lower production costs and better protection of the environment are required. Location and navigation for monitoring purposes as well as for site specific operations within a crop field is required for environmental oriented agriculture. It can lower inputs of farm chemicals and nutrient infiltration. Location sensing is used for simple yield monitoring and for application monitoring in water protection areas. The needed accuracy is within 1 to 5 m which can be accomplished by GPS (Global Positioning System) with post processing or by DGPS (Differential GPS). Overlaps and gaps during application of organic and mineral fertilizer and pesticides could be avoided with navigation. Accuracy for this task must be less than or equal to +/- 10 cm. Most precise navigation within a +/- 1 cm range will take place in tractor and implement guidance. These techniques are essential to switch from chemical to mechanical weed control and to get a more powerful performance under optimum conditions with more and more automized vehicles. Satellite navigation can fulfill the present needs within an accuracy of +/- 1 m down to +/- 10 cm. For more exact field work it should be supplemented by dead reckoning systems, other ground based navigation systems or by machine vision. ESA

N93-23529# Centre National d'Etudes Spatiales, Toulouse (France).
TOWARDS GLOBAL SATELLITE NAVIGATION **c04**
J. M. Durand *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 121-125 (For primary document see N93-23507 08-43)
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The Global Positioning System (GPS) will offer extremely high navigation performance and has a promising future for most civil navigation neeeds. The GLONASS (Russian GPS) system is similar to GPS in its objectives. However, GPS and GLONASS have separately three major disadvantages for civil user: insufficient integrity, since many simultaneous users can obtain false positions and remain unaware of the problem; insufficient availability, since users can be unable to obtain a position fix or else can obtain a result with significantly degraded performance; for GPS only, deliberate spatio-temporal degradation ('selectice availability') of system performance, the characteristics of which are kept secret. Many solutions to these problems have been put forward. The comparison leads to the recommendation of a system to monitor the status of the GPS satellites and broadcast the information to users. The characteristics of such messages would be as similar as possible to those of GPS messages. Such a system is known as Geostationary Overlay, or GPS Integrity Channel (GIC) or European Complement to GPS (CE-GPS). These different points are developed and the status of the subsequent international coordination is considered. ESA

N93-23530# Kayser Threde G.m.b.H., Munich (Germany).
COMLINE **c32**
N. Balteas *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 127-131 (For primary document see N93-23507 08-43)
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COMLINE is primarily a single channel satellite based communication capability for educational applications. The primary goal of COMLINE is to establish a worldwide (hot) communication line for schools and highschools with adequate groundstations, to enable scholars and students to get experience with space problematics, innovative techniques and technologies via useful and practical applications. The communication with the satellite can be established from the classroom and an antenna on the roof or even with a dipol antenna on the way. Because of the ultralightweight groundstations, which are required to establish the communication and the worldwide coverage of polar satellites, these links can also be used on a variety of mobile communication applications for packet radio data transmission. It can even be used for backup emergency communications after environmental disaster. ESA

N93-23531# DMT Martinetetechnik G.m.b.H., Hamburg (Germany).
FLEET MANAGEMENT BASED ON SATELLITE POSITIONING AND COMMUNICATION **c32**
Bernd Hossfeld *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 133-134 (For primary document see N93-23507 08-43)
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Computerized systems for vehicle location, communication and fleet management provide permanent and direct on route access to the fleet. Thus time schedules, routes and cargo assignments can be optimized. Transport hazards can be identifed and minimized or avoided. The functionality of such a system is based on the following matched components: sufficiently accurate positioning of each vehicle based on GPS (Global Positioning System); communication system, functioning no matter what the position of the vehicle is via Inmarsat; centralized, computer based management system, which will keep the dispatcher free from routine tasks, provide hints for decision finding in tactical situations, enables access and control based on a digital map information system. ESA

N93-23532# Jena-Optronik G.m.b.H. (Germany).
A STAR PATTERN RECOGNITION SENSOR (SPRS) OF HIGH ACCURACY: A CONTRIBUTION TO NEW POSSIBILITIES OF AUTONOMOUS ATTITUDE DETERMINATION **c19**
W. Skarus, D. Ratzsch, and C. Elstner *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 135-139 (For primary document see N93-23507 08-43)
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Using CCD (Charge Coupled Device) arrays in connection with modern image processing algorithm a new generation of starsensors with entirely new utilization features was developed in the late 1980s. They were successfully applied in missions like Astro-C, Granat and Rosat as components of the attitude measuring system and as a reference system for scientific instruments. In all applications the star sensors were used as so called trackers; they compute and put out the coordinates of the registered stars only. The potential possibilities of a star sensor are not fully utilized this way. Considering the inertial character of the natural starry sky a direct attitude determination is possible by applying an 'intelligent' star sensor which is able to recognize the registered star pattern and, thus, to calculate the sensor's attitude. A European prototype of such a star pattern recognition sensor, the Astro 1, was developed and manufactured. Both in-orbit and on-ground test results of the SPRS are presented. ESA

N93-23533# Inmos Ltd., Bristol (England).
AN INTEGRATED CAR NAVIGATION SYSTEM USING A SINGLE PROCESSOR FOR GPS SIGNAL PROCESSING, POSITIONING, MAP DISPLAY, AND REPORTING **c04**
Philip G. Mattos *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 141-145 (For primary document see N93-23507 08-43)
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GPS (Global Positioning Systems) engines are now available at around 400 dollars. This is both too high for the car manufacturer, and too low to entice new players into the marine market. Integrating the application work into the GPS processor reduces costs by a very large margin, saving processor, ROM's (Read Only Memories), RAM (Random Access Memory) and interfacing. Novel map handling techniques, and low cost LCD (Liquid Crystal Displays), mean that the entire map display and GPS sensor can execute on the same CPU (Central Processing Unit). The position reporting role, where the driver has no display, is even simpler, as much of the work can be delegated to the central base station, allowing a single 16 bit transputer, with only a single ROM and no external RAM to fulfil the task. ESA

N93-23534# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (Germany).
NAVSAT: AN APPLICATION OF GPS AND GLONASS FOR THE CIVIL USER COMMUNITY **c04**
Martin Haunschild, N. Niklasch, B. Eissfeller (Kayser Threde G.m.b.H., Munich, Germany.), A. Jansche (Kayser Threde G.m.b.H., Munich, Germany.), J. Merkel (Stuttgart Univ., Germany.), and W. Schaefer (Stuttgart Univ., Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 147-152 (For primary document see N93-23507 08-43)
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NAVSAT is a civil complement to the satellite navigation systems NAVSTAR GPS (US Global Positioning System) and GLONASS (Russian GPS). Using these systems as a base with proven performance characteristics, the build up of a kernel system for a future civil satellite navigation system is intended. A proposal to solve the integrity problem of GPS and GLONASS for civil aviation requirements and to enhance the availability, coverage and accuracy is considered. These tasks will be attained by aid of small navigation payloads flown on suitable host satellites, using a navigation signal with a structure that is compatible to GPS and GLONASS, an appropriate ground segment for navigation signal uplink, satellite position determination, time transfer, communication and set of health minitoring units in the responsibility of national aviation authorities. In the future, this basic constellation may be augmented by additional geostationary and Tundra type satellites to achieve a global service. ESA

N93-23535# Kayser Threde G.m.b.H., Munich (Germany).
ON-LINE HEALTH MONITORING: AN INTEGRITY IMPROVEMENT FOR THE CIVIL USE OF GPS AND GLONASS **c04**
B. Eissfeller, Martin Haunschild (Maschinenfabrik Augsburg-Nuernberg A.G., Munich, Germany.), A. Jansche, and N. Niklasch (Maschinenfabrik Augsburg-Nuernberg A.G., Munich, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 153-157 (For primary document see N93-23507 08-43)
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The development of an experimental Health Monitoring Unit (HMU) for GPS (Global Positioning System) and GLONASS (Russian GPS) is reported. The purpose of the HMU is to provide timely warnings to the navigation users of the satellite navigation systems if the satellite navigation systems are not used for navigation. The monitoring unit is a key element in the integrity channel concept of a civil overlay NAVSAT to GPS and GLONASS. The most stringent requirements are those of civil aviation: in the nonprecision approach phase horizontal position errors exceeding the 600 m SPE thereshold have to be reported within 10 seconds. The concept of the HMU is to use a GPS receiver as well as a GLONASS receiver in a known location in order to detect large pseudorange errors and to identify the malfunctioning satellites. This means that the station is able to work autonomously. It will also provide pseudorange errors compatible with the American RTCA SC-159 approach and for a future wide area DGPS (Differential GPS) system. ESA

N93-23536# SPOT Image Corp., Toulouse (France).
MAP PRODUCTION AND UPDATING USING SPOT DATA AND SPOT DATA DERIVED PRODUCTS
Jean-Claude Rivereau, Philippe Munier, and Serge LeBlanc *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 163-167 (For primary document see N93-23507 08-43)
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The use of SPOT data on cartography is described. From concept and design to actual tested performances, SPOT imagery is perfectly adapted to cartographic applications. Regular topographic mapping or map updating is achieved at scales ranging from 1:100,000 to 1:25,000 and products such as image maps and digital elevation models are emerging. SPOT georeferenced image maps are used both as a source to extract up to date geographic information and as a base to transfer information. The development of new products is driven by the users' requirements to integrate various sources of information and three products are developing particularly rapidly: analogic image maps which include graphic elements inlaid into the image; digital image maps designed as a direct input to geographic information systems, and digital elevation models extracted from SPOT stereopairs by automatic correlation. SPOT data is therefore considered as a good alternative to carry out cartographic surveys and a basic tool to generate new products for integrated geographic information. ESA

N93-23537# Institut Geographique National Espace, Toulose (France).
IMAGE MAPS
Bertrand Galtier and Alain Baudoin (Centre National d'Etudes Spatiales, Toulouse, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 169-173 (For primary document see N93-23507 08-43)
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The concept of image maps is presented and illustrated with the example of a project in Bangladesh using SPOT satellite imagery. The success of the product which may derive from commercial, economical and technical considerations is assessed and the necessary conditions for producing image maps at an industrial rate are analyzed. Image maps can only succeed if they are produced on a competitive basis. ESA

N93-23538# Technische Univ., Berlin (Germany). Dept. of Photogrammetry and Cartography.
THE PRODUCTION OF SATELLITE IMAGE MAPS: EXPERIMENTS AT THE TECHNICAL UNIVERSITY OF BERLIN
Joerg Albertz, Hartmut Lehmann, and Ruediger Tauch *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 175-180 Sponsored by DFG and BMFT (For primary document see N93-23507 08-43)
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The production of satellite image maps using a digital image processing software system is reported. The production line is described: preprocessing, geometrical mosaicking and rectification, radiometrical mosaicking, merging of multisensor data, postprocessing, cartographic processing, and rasterplotter printing. The generation of a digital terrain model for SPOT stereo data and its application to improve geometrical processing was tested with good results. An experiment making use of photographic data is described. ESA

N93-23539# GEC-Marconi Research Centre, Guildford (England).
PRECISION GEOCODING DEMONSTRATOR SYSTEM
J. E. Laycock and J. Whalley (Earth Observation Sciences Ltd., Guildford, England.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 181-184 (For primary document see N93-23507 08-43)
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An overview of a geocoding system designed as stand alone, which with a minimum of modifications can be adapted to interface with any SAR (Synthetic Aperture Radar) processor generating imagery in zero Doppler coordinates and being adequately annotated, is presented. The context and functionality of the system are described, and some of the key design issues, such as the tie-pointing approach, the generation of ancillary maps, the resampling methods adopted, and implementation considerations are discussed. ESA

N93-23540# Technische Univ., Hanover (Germany).
COMPARISON OF MAPPING WITH DIFFERENT SATELLITE IMAGES
K. Jacobsen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul.

1992 p 185-189 (For primary document see N93-23507 08-43)
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The geometric and cartographic potentials of space images are explored. The complete coverage with actual maps of at least 1:50,000 is a basic demand for the development of any country. With the traditional methods of mapping, a complete coverage of the world may be reached within the next 20 years but there is no tendency to solve the problem of updating. In using images taken from space this problem can be solved. Images made with the following cameras were investigated: Metric Camera (MC), Large Format Camera (LFC), KFA1000, KATE200, MK4, and SPOT. With the exception of the KATE, the achieved horizontal accuracy in mapping is sufficient. The main information necessary for maps 1:50,000 is available in images taken with the LFC, KFA, MK4, and SPOT. Optimal results were achieved in photos from the operational systems KFA followed by SPOT and MK4. ESA

N93-23541# Politecnico di Milano (Italy). Dipt. di Elettronica.
INNOVATIVE APPLICATIONS OF REPEATED SATELLITE SAR SURVEYS
Fabio Rocca and Claudio Prati *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 193-197 (For primary document see N93-23507 08-43)
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Applications of repeated satellite Synthetic Aperture Radar (SAR) surveys are presented with available experimental results. SAR is a microwave coherent imaging system which has day, night and all weather capabilities. By using synthetic aperture and pulse compression techniques, much higher ground resolution is achieved than with conventional radars. SAR coherence can be exploited for innovative applications of repeated surveys from satellite: digital elevation map generation, improvement of ground range resolution, and measurement of small changes of the terrain. ERS-1 SAR mission represents a good opportunity for testing these applications. ESA

N93-23542# Institut Geographique National, Paris (France).
BLOCK TRIANGULATION OF SPOT DATA WITH PARTICULAR REFERENCE TO THE OEEPE TESTS
I. Veillet *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 199-202 (For primary document see N93-23507 08-43)
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Block triangulation is a major step in processing geometrically a great number of SPOT images to cover a large area on a mapping project. This method regularly used in aerial photogrammetry can be used as well for SPOT photogammetry. OEEPE (European Organization for Experimental Photogrametric Research) tests were set up to evaluate this method and they confirmed the potential of SPOT system for topographic mapping. ESA

N93-23543# Bell Telephone Mfg. Co., Antwerp (Belgium).
COMMUNICATIONS TECHNIQUES SUPPORTING THE DATA MANAGEMENT **c32**
P. Dosiere *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 203-207 (For primary document see N93-23507 08-43)
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The current situation for the acquisition and circulation of Earth observation data is reviewed and the progress which can be expected from the announced new technologies is assessed. Advantages and drawbacks are identified. Some recommendations for an optimal use of the communication resources are presented. A simple way to reduce investment cost is to combine the programs which require communication equipment. In conclusion, the advantages of the Data Relay System (DRS) are particularly perceivable in terms of acquisition capability for the high data rate sensors, such as the optical imagers or the synthetic aperture radar. The advantage of using specific networks will be observable for the transfer of data between the data acquisition and the processing and archiving facilities and user home bases, not only because of the high data rate transfer capability of the future European networks but also because of the services proposed together with these networks. ESA

N93-23544# Geodetic Inst., Helsinki (Finland).
MAPPING FROM SPOT DATA
E. Ahokas, J. Jaakkola, and P. Sotkas *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 209-213 (For primary document see N93-23507 08-43)
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The interpretability of different SPOT data in mapping applications is described. Four different scenes, 2 multispectral images and one panchromatic stereopair, from an area of 20 by 30 km in southern Finland were available. Five institutes made nine different interpretations using digital and visual methods. The interpretation results were compared against reliable ground truth. From all SPOT data, only three classes (water, agricultural lands, and forests) could be interpreted accurately. All streets down to the width of 5 m could be detected using visual methods. Best results were obtained using some combination of visual and digital interpretation. ESA

N93-23545# National Aerospace Lab., Amsterdam (Netherlands).
SYSTEM DESIGN FOR ARTEMIS ENVIRONMENTAL MONITORING
H. A. vanIngenSchenau and J. Spaa *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 215-218 (For primary document see N93-23507 08-43)
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Aspects of system design applied to the ARTEMIS (Africa Real Time Environmental Monitoring using Imaging Satellites) environmental monitoring system of the Food and Agriculture Organization (FAO) of the United Nations are described. The design aspects are derived from characteristics of the monitoring function and are based on methods of rainfall and vegetation monitoring from satellite observations which are widely accepted for the user community. The satellites which meet the requirements for large scale monitoring purposes are the Meteosat geostationary and NOAA polar orbiting satellites. The thematic data processing is based on the method of ten day cumulation of Meteosat infrared data for rainfall estimation and the method of ten day composition of NOAA visible and near infrared data to determine the vegetation index. All processed images and maps are stored in an image database to build a long term archive. The information is used in the FAO monitoring programs and in regional and national institutes in Africa. ESA

N93-23546# Academy of Sciences, Potsdam (German D.R.). Geoforschungszentrum.
APPLICATIONS OF SATELLITE DATA ON SEISMIC RISK ASSESSMENT: STRAIN ANALYSIS OF FAULT LINEAMENT SYSTEMS **c46**
P. Bankwitz and E. Bankwitz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 219-224 (For primary document see N93-23507 08-43)
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Strain data and analysis from selected seismoactive areas (Tienshan (central Asia), Tibet, and Turkey) are presented with a theoretical background on the use of remote sensing in geological research. Satellite data supply information in crystal deformation is considered. If sufficient fault traces are extracted from images, models of occurrence and distribution of differing strain intensities along tectonic and seismotectonic zones can be deduced. The strain analysis method allows the characterization of different images of a similar scale in regard to the deformation of the crust. This deformation

analysis of selected regions is an additional method for remote sensing technology and seismic risk evaluation. ESA

N93-23547# Aerospatiale, Cannes (France).

POTENTIALITIES AND LIMITATIONS OF TOPOGRAPHIC MAPPING FROM SYNTHETIC APERTURE RADAR

Laurent Polidori *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 225-228 (For primary document see N93-23507 08-43)

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The state of the art in radar mapping is presented and potentialities and limitations for topographic mapping are identified. Due to its great sensitivity to relief and its capability of all weather imaging, synthetic aperture radar is a very promising tool for mapping. Three main techniques can be used for topographic mapping from radar images: radargrammetry, shape from shading, and interferometry. Since these mapping techniques do not have the same practical constraints concerning image quality and orbit configuration, the technique may be preferred to the others for a given data set. ESA

N93-23548# Geological Survey, Reston, VA.

THE ORBITAL IMAGING SYSTEM AND ITS POTENTIAL FOR DIGITAL TERRAIN MODELS OF THE EARTH

Donald L. Light *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 231-242 (For primary document see N93-23507 08-43)

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An Orbital Imaging System (OIS) to provide imagery data capable of meeting standards for 1:50,000 scale products, including digital topographic model information, is proposed. The proposed OIS would repeat coverage of the Earth every 22 to 45 days with 5 m panchromatic pixels from its convergent stereo linear arrays covering a swath width of 64 km. The sensor would also contain sufficient multispectral bands with 10 to 30 m pixels for a wide variety of international Earth science data users. A system such as the OIS would provide the global image base needed to define vegetation and to produce digital terrain models for global change research and other applications around the globe. ESA

N93-23549# MacDonald, Dettwiler and Associates Ltd., Richmond (British Columbia).

DELIVERY OF INFORMATION FROM EARTH OBSERVATION SATELLITES

J. S. MacDonald *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 243-249 (For primary document see N93-23507 08-43)

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The requirements for handling data from Earth observation systems are addressed. Starting from the premise that the objective is to acquire an understanding of the state and evolution of Earth, an argument that Earth observation satellite systems are, in reality, systems for delivering information, is developed. This view has implications on how the design of such systems can be approached, and how the data that they produce can be handled in order to derive maximum benefit. These issues are examined, and some of the technical requirements for future satellite based Earth observation systems are put forward, based on the concept that Earth observation is a quantitative measurement discipline that is driven by requirements for information. ESA

N93-23550# Joanneum Research Centre, Graz (Austria). Image Processing and Computer Graphics Inst.

MULTISENSOR DATA APPLICATIONS FOR DIGITAL LANDSCAPE MODELS

M. F. Buchroithner, J. Raggam, D. Strobl, and A. Almer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 251-257 (For primary document see N93-23507 08-43)

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Multisensor image data originating from various remote sensing missions and going along the trend towards digital photogrammetry can be integrated into Digital Landscape Model (DLM) data bases. For this, the images have to be geocoded into a common cartographic reference system. This is based on the use of parametric mapping models and the integration of a Digital Elevation Model (DEM) to compensate for terrain induced as well as for sensor specific geometric distortions. Hence, complementary to image processing systems and geographic information systems, an appropriate software fulfilling these requirements is an essential tool to link multisensor image data with DLMs. With the workstation Remote Sensing software package Graz (RSG), a comprehensive tool is available, for general geometric treatment, goecoding of, and strereo mapping with multisensor image data. ESA

N93-23551# Saga Univ. (Japan). Dept. of Information Science.

INFLUENCE DUE TO SATELLITE ATTITUDE JITTER ON ESTIMATION OF DIGITAL ELEVATION MODEL (DEM)

Kohei Arai, S. Mukai, Hiroshi Watanabe (JAPEX Geoscience Inst., Tokyo, Japan.), T. Tsukada (JAPEX Geoscience Inst., Tokyo, Japan.), and T. Tagawa (Earth Resources Satellite Data Analysis Center, Tokyo, Japan.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 259-262 (For primary document see N93-23507 08-43)

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Theoretical accuracy assessment of the Digital Elevation Model (DEM) to be derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) of the EOS-a1 (Earth Observing System-a1) platform was conducted under the assumptions of with/without Ground Control Point (GCP). Root mean square error in terms of DEM estimation accuracy was found to be 27.98 m with GCP while that without GCP was 35.68 m. An influence due to satellite attitude jitter other than attitude change in terms of modulation transfer function degradation was assessed under the assumption of a sinusoidal motion. ESA

N93-23552# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany).

SEMI-AUTOMATIC DERIVATION OF DIGITAL ELEVATION MODELS FROM STEREOSCOPIC 3-LINE SCANNER DATA

M. Lehner and R. S. Gill (Computer Anwendung fuer Management G.m.b.H., Munich, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 263-268 (For primary document see N93-23507 08-43)

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The development of image matching software for automatically locating large numbers of conjugate points in three line stereo scanner imagery is reported. It is based on areal matching in image pyramids and subsequent local least squares matching for subpixel positioning. Modified photogrammetric adjustment software is used to derive Digital Elevation Models (DEM) and exterior orientation prameters. This combined point determination software is mainly based on collinearity equations for conjugate and ground control points. It allows for the constraining of the exterior orientation of the camera by given flight path and attitude data and by Gauss-Markov statistical processes. The successful applications of the software to airborne data taken with the satellite model of the MEOSS (Monocular Electro Optical Stereo Scanner) camera, including a comparison to an already existing DEM, is reported. ESA

N93-23553# Centre National de la Recherche Scientifique, Strasbourg (France). Lab. Environnement-Cartographie-Teledetection.

DATA FOR MAP ALGEBRA [DONNEES POUR UN ALGEBRE DE CARTES]

Sylvie Rimbert (Groupement Scientifique de Teledetection de Strasbourg, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 271-275

In FRENCH (For primary document see N93-23507 08-43)
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A review on transformation methods in geographic image processing is given, with examples concerning 'qualitative data. Transformations of a digital image by another image or matrix, with the intervention of an operator, or 'map algebra', is the data processing method within Geographic Information Systems (GIS). The quality of the data depends on the methodological process and the way in which the operative structures are introduced in the GIS 'toolboxes'. ESA

N93-23554# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
A DIGITAL LANDSCAPE MODEL FOR EUROPE (DLME)
B.-S. Schulz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 277-279 (For primary document see N93-23507 08-43)
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The Digital Landscape Model for Europe (DLME) is a pilot project of OEEPE (European Organization for Experimental Photogrammetric Research). It serves the utilization of remotely sensed digital and analog recordings from space in order to determine the basic data for a landscape model such as areal, linear, and, if possible, punctiform topographic objects including relief and highly differentiated land uses. The concept comprises: the integration of different sensors, recording dates, and spectral channels; the development of sensitive methods and their automation for the evaluation of data under radiometric and geometric aspect; and the linkage of the respective results with additional information describing the function of objects. The methodical developments are discussed with regard to their integration into the concept and their further development. ESA

N93-23555# Commission of the European Communities, Brussels (Belgium).
IMAGE TREATMENT AND GEOGRAPHICAL INFORMATION SYSTEMS AT THE SERVICE OF THE COMMON AGRICULTURAL POLICY
Michel vandeSteene, Jacques Delince (Joint Research Centre of the European Communities, Ispra, Italy.), and Damien Lepoutre (Geosys, Ramonville, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 281-285 (For primary document see N93-23507 08-43)
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A remote sensing assisted control scheme of some surface based subsidies within the Common Agricutural Policy was devised, starting from the experience of the JRC (Joint Research Center of the Commission of the European Communities) developed in the MARS (Monitoring of Agriculture by Remote Sensing) Project. This scheme was tested in 1991 and is applied in 1992 as an option by nine Member States, to monitor oil seeds and set-aside subsidies, in a selected sample. National administrations run the administrative preliminary and final controls, while specialized forms check the declarations of fields made by the farmers against the interpretation of SPOT multispectral or LANDSAT Thematic Mapper images, with the aid of a geographical information system including the land register maps. ESA

N93-23556# RSDE S.R.L., Milan (Italy).
VINEYARD CADASTRE MONITORING USING REMOTE SENSED DATA IN AN INTEGRATED GIS
A. Annoni, R. Arcozzi (Region of Emilia-Romagna, Bologne, Italy.), G. Orlandi (Region of Emilia-Romagna, Bologne, Italy.), and G. Onesti (Modena Commune, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 287-291 (For primary document see N93-23507 08-43)
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The acquisition of knowledge of vineyard surfaces, as according to the needs of European Economic Community (EEC), who require the true estimation of the EEC farmer's production for correct economical policy planning in agricultural field is addressed. The research and the results of the test performed on the Modena plain, Italy (about 50,000 hectares of which 4,000 are vineyard) devoted to define an operative methodology to be applied to the whole territory of the Emilia Romagna region are described. The main aspects of this job regards the integrated use of remotely sensed data and cartographic (cadastre) data by means of an integrated Geographic Information System (GIS). The proposal methodology is a synergism of automatic detection of changes and visual photointerpretation assisted by computer. In the first phase the cadastre is created by means of ground survey or aerial photo utilization; in the second phase an attempt is made to detect the changes also with the base of multitemporal satellite image analysis. ESA

N93-23557# International Inst. for Aerospace Survey and Earth Sciences, Enschede (Netherlands).
THE INFLUENCE OF GEOLOGY AND GEOMORPHOLOGY ON LANDSLIDE HAZARDS IN AN AREA IN THE COLOMBIAN ANDES: THE GIS APPROACH
C. J. vanWesten and H. M. G. Kruse *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 293-298 (For primary document see N93-23507 08-43)
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The preparation zonation maps with the help of Geographic Information Systems (GIS) is addressed. The GIS approach enables the statistical and deterministic analysis of the influence of geological and geomorphological factors in hazard occurrence. A research project in which methodologies are developed for hazard analysis at various levels of scale is described: regional scale (1:100,000 to 1:250,000), medium scale (1:25,000 to 1:50,000) and large scale (1:5,000 to 1:15,000). The differences in scale lead to differences in available input maps, remote sensing imagery, and other data and to differences in the details of the output zonation maps. ESA

N93-23558# Groupement Scientifique de Teledetection de Strasbourg (France). Lab. Environnement, Cartographie, Teledetection.
ESTIMATION OF RUNOFF AND EROSION USING GIS INTEGRATING DEM, LANDSAT DATA, AND TERRAIN HYDROLOGICAL DATA [ESTIMATION DU RUISSELLEMENT ET DE L'EROSION PAR L'UTILISATION DE SIG INTEGRANT UN MNT, DES DONNEES LANDSAT ET DES DONNEES HYDROLOGIQUES DE TERRAIN]
Thea Vogt and Dieter Gomer (Karlsruhe Univ., Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 299-303 In FRENCH (For primary document see N93-23507 08-43)
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The use of GIS (Geographic Information Systems) to address problems of soil degradation and resorvoir sedimentation in semi arid regions is reported. The Oued Mina (Algeria) watershed was chosen as a test area for developing measurement methods to improve water and soil conservation. The study area, about 1,000 sq km wide, mainly consists of marls with a more or less preserved soil cover and bad-lands as a major feature in places. By processing LANDSAT TM data a principal component analysis was obtained providing information about the soil wetness; the soils were classified by stepwise discriminant analysis. Runoff production and sediment load were determined for each soil type. Slope, aspect,and watershed size for each pixel were derived from a DEM (Digital Elevation Model). Modeling runoff and soil erosion for a test area is shown using partial area concept combined with hydrological runoff model. ESA

N93-23559# Bureau de Recherches Geologiques et Minieres, Orleans (France).
REMOTE SENSING LANDSLIDE HAZARD MAPPING USING GIS TECHNOLOGY IN COLOMBIAN ANDES
E. Leroi, O. Rouzeau, J. Y. Scanvic, J. Chorowicz (Paris VI Univ., France.), and G. Vargas (Ingeominas, Bogota, Columbia.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 307-310 (For primary document

see N93-23507 08-43)
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An approach to landslide hazard mapping, a major challenge for most of the Latin American countries, based on a range of satellite products is presented. Remote sensing, and particularly SPOT sterescopic image interpretation and classification, now provides the basic information for surface lithology, tectonics, land use, biomass, and makes possible calculation of a digital elevation model used to quantify geomorphology. Raster mode GIS (Geographic Information System) can determine crucial criteria for slope instability, calculate their value, propose a probabilistic model, and prepare a landslide hazard mapping at a scale ranging from 1:25,000 to 1:50,000. Such a methodology was applied in a pilot experimental study in the upper Chicamocha Valley, Colombian Andes. ESA

N93-23560# Swedish Space Corp., Solna.
EXTRACTION OF INFORMATION FROM SATELLITE IMAGERY TO A GIS FOR ENVIRONMENTAL MONITORING OF THE MINING AREAS IN NORTHEASTERN ESTONIA **c45**
M. Oeberg, T. Lindell (Uppsala Univ., Sweden.), J. Nisell (Uppsala Univ., Sweden.), and L. Saare (Estonia Nature Management Scientific Information Centre, Tallinn.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 311-315 Presented at 3rd European Conference on Geographical Information Systems (For primary document see N93-23507 08-43)
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The mining of oil shale in northeastern Estonia involves some 500 sq km of which approximately 85 sq km is open cast mines. Direct effects of mining activities as well as indirect effects from combustion of the oil shale have become the main environmental problem of the region. A pilot project was initiated for cooperation and exchange of data to derive selected information relevant to environmental monitoring from satellite imagery. The common platform for data exchange is the ARC/INFO system. The project involves on screen extraction of selected cartographic features and comparison with 1:50,00 topographic maps. The development of the open cast mining area between 1986-1991 was studied by digital change detection, using LANDSAT and SPOT multispectral data. A supervised land use classification was carried out to quantify areas that may be threatened by future mining activities. Results were transferred to the ARC/INFO vector GIS (Geographic Information System). ESA

N93-23561# Atlantide Grenat Logiciel, Brest (France).
REMOTE SENSING APPLIED TO MAPPING AND OTHER PURPOSES: STADIS PROJECT, A PRACTICAL EXAMPLE IN TUNISIA
P. Y. Bouf and M. A. Tanne *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 317-320 (For primary document see N93-23507 08-43)
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A project to create a library of satellite images to solve particular problems arising in Mediterranean countries such as Tunisia is reported. In the case of Tunisia, images are needed to solve environmental problems, and in particular a complete view of desert growth, mapping in rough country, urbanism, soil occupation, hydrology, etc., is required. Images used in this project (STADIS) are from NOAA, LANDSAT, and SPOT. A technical description of the system is given, and the man machine interface and specific archive problems are outlined. ESA

N93-23562# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany).
THE ERS-1 RADARMAPS OF GERMANY AND THE ANTARCTIC PENINSULA
D. Kosmann, A. Roth, G. Schreier, and R. Winter *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 321-326 (For primary document see N93-23507 08-43)
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The use of ERS-1 Synthetic Aperture Radar (SAR) image data for land applications is described. As one of the dominant data and information evaluation tools for land applications are geo-information systems, the spaceborne SAR data will be geocoded for higher level use and will be available for large areas in order to allow quasi operational applications. Both themes are addressed by the research projects of a Radarmap of Germany and the Antarctic Peninsula. Though the sensor and the data will be the same, both projects envisage different goals. Within the Radarmap of Germany, a high resolution and precise geometrically rectified data set will be generated. While generating this dataset, problems of terrain correction and mosaicking of SAR data will be addressed. The entire data set will be stored online in a large optical disk juke box system. Within the radarmap of the Antarctic Peninsula, the ERS-1 data received at the German Antarctica receiving station and processed with a real time processor will be used to geocode and mosaic the data. The real time 100 m pixel browser images allow fast monitoring of polar ocean and glacier phenomena. ESA

N93-23563# University Coll., London (England). Dept. of Photogrammetry and Surveying.
SATELLITE IMAGE MOSAICS FROM AUTOMATIC SCENE RE-NAVIGATION
A. Newton, A. Mandanayake, K. Tildsley, and J.-P. Muller *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 327-332 Sponsored in part by Kunst- und Ausstellungshalle der Bundesrepublik Deutschland (For primary document see N93-23507 08-43)
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The development of an automated satellite multi-image registration and mosaicking system, based on automatic tie-point extraction and navigation correction, for AVHRR (Advanced Very High Resolution Radiometer), TM (Thematic Mapper), and Viking Orbiter, and pregeocoded images is reported. The geometric aspects of image to image and image to ground registration form the core of any such work. However, a significant amount of preprocessing and some post processing needs to accompany this in some cases, in particular for AVHRR. Results for AVHRR multi-scene registration in the Rondonia area of Brazil and pre-geocoded LANDSAT TM imagery of northern Germany are presented. Initial estimates of accuracy shows RMS inter-scene registration of 0.7 km (0.64 pixels) for four resampled AVHRR scenes in Rondonia. ESA

N93-23564# Florence Univ. (Italy). Dipt. of Ingegneria Elettronica.
MULTISPECTRAL INTELLIGENT FUSION TECHNIQUES
V. Cappellini and A. Mecocci *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 335-340 Prepared in cooperation with Science for Environment Foundation, Florence, Italy (For primary document see N93-23507 08-43)
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The interest of using 'fusion' and integration operations on data and images from different sensors to obtain more significant results is outlined. It is shown how the fusion operation is of great utility especially for images obtained from space sensors, which differ in data format and in spectral, spatial, or temporal resolution. Several data fusion techniques are reviewed for multisensory data (from multiple remote sensors) with particular reference to scoring models and structure models. A special system for the fusion of space remote sensing multispectral data, based on a G-Net model, is presented, in particular to obtain an efficient image segmentation. The G-Net is an evolution of a Petri net, and can represent both factual (static) knowledge and procedural (dynamic) knowledge in a uniform way. Results obtained by using multispectral LANDSAT TM images are reported. ESA

N93-23565# Systems Designers Ltd., Camberley (England).
THE USE OF MULTIPLE LINKED SELF-ORGANISED ARTIFICIAL NEURAL NETWORKS FOR CLASSIFICATION OF REMOTELY SENSED IMAGES
D. J. Lewis, D. G. Corr, C. R. Gent, and C. P. Sheppard *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 341-345 (For primary document see N93-23507 08-43)
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A study on the use of unsupervised multiple linked self organized neural networks for the classification of remotely sensed data is presented. The advantages and limitations of these networks are investigated. The power of the method is demonstrated using Meteosat imagery. Training on only 5 percent of one dataset permits accurate classification of many datasets. ESA

N93-23566# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.
NEURAL NETWORK METHODS FOR ANALYSIS OF REMOTELY-SENSED SATELLITE DATA
I. Kanellopoulos, G. G. Wilkinson, A. Varfis, and J. Megier *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 347-349 (For primary document see N93-23507 08-43)
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Experiments conducted on the classification of remotely sensed satellite imagery using multilayer perceptron neural networks are reported. The implementation of such networks yields results of high accuracy. Training of large networks required for realistic satellite mapping applications can require several hours of computer processing, although classification can be performed very rapidly. Some indications are given of techniques to design appropriate network architectures and to control the training procedures for fast convergence. The neural network method is being evaluated in several operational projects. ESA

N93-23567# RSDE S.R.L., Milan (Italy).
REMOTE SENSING AND LAND USE IN THE REGION OF TUSCANY (ITALY). A NEW METHODOLOGY FOR THE INTEGRATION OF VERY HETEROGENEOUS DATA
A. Annoni, C. Attardo, A. Cumer, A. Greggio (Department of Agriculture and Forests, Tuscany, Italy.), A. Merendi (Department of Agriculture and Forests, Tuscany, Italy.), R. Rossi (Department of Agriculture and Forests, Tuscany, Italy.), and M. Trevisani (Dipartimento Urbanistica, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 353-358 (For primary document see N93-23507 08-43)
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A program concerning the definition of an operative methodology for the regular update of the detailed knowledge of information concerning territory for agricultural/forestry planning, urban and environment management is reported. The great number of points covered by the regional forest inventory of Tuscany (Italy) (about 150,000 point samples on a grid of 400 by 400 m), and the use of the other data available (aerial high altitude photos, digital terrain model, and panoramic photos of the surveyed points) permit a correct support for remote sensing applications. The methodology to integrate all the available data is described, taking account of the following problems: integration of data of different nature and support, of different age, scale, and classification. A particular emphasis is put on the integrated use of data with a geographic information system, permitting the use of raster and vector data and the quick update of the modified land use. ESA

N93-23568# Consiglio Nazionale delle Ricerche, Florence (Italy). Inst. of Environmental Analysis and Remote Sensing for Agriculture.
ASSESSMENT OF ACTUAL LAND USE BY MEANS OF AN INTEGRATED LIS
C. Conese, F. Maselli, M. Romani, and L. Bottai *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 359-362 (For primary document see N93-23507 08-43)
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A methodology based on the use of an integrated Land Information System (LIS) is put forward to improve the performance of automatic classifications based on remotely sensed data. In a case study about a rural area in Tuscany (Italy), some thematic maps reporting morphology and geology were digitized and inserted into the system. The statistical associations between these factors and the distributions of the main cover categories were found and used as prior probabilities for a maximum likelihood classifier with multitemporal thematic mapper scenes. The utilization of ancillary information leads to notable improvements in the discrimination capability of the classifier. ESA

N93-23569# Freie Univ., Berlin (Germany).
APPLICATION OF REMOTE SENSING AND GIS. TECHNOLOGY TO NATURAL RESOURCES MANAGEMENT: SELECTING RICE FIELDS IN VIETNAM
Pham Viet Cuong (Institute of Geography and Natural Resources, Hanoi, Vietnam.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 363-368 (For primary document see N93-23507 08-43)
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The results of geographic spatial analysis to evaluate land resources for agricultural infrastructure development is reported. Vietnam is an agricultural, developing country with a high population density. Local inhabitants in many places are exploiting forest and agricultural resources, creating a negative impact on production and the people's living. To cope with this problem, the trend in Vietnam is now for promotion of agricultural infrastructure development using regional Geographic Information Systems (GIS). A multilevel GIS based on image processing and GIS technology for regional planning, management, and division making under a tropical monsoon climatic regime was installed. The study reported is divided into three phases: loading of products from remote sensing data and existing maps; importing this data for management in the GIS; and demonstrating the suitability of application for rice fields development. ESA

N93-23570# Consiglio Nazionale delle Ricerche, Milan (Italy). Remote Sensing Dept.
INTEGRATION OF REMOTE SENSING AND GIS DATA FOR A MULTISCALE STUDY OF THE PO RIVER BASIN
M. A. Gomarasca, M. Antoninetti, P. A. Brivio, A. Moriondo, F. Pagnoni, A. DellaVentura, A. Rampini, and R. Schettini *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 369-373 (For primary document see N93-23507 08-43)
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Preliminary results in designing a Geographic Information System (GIS) by which different aspects of the Po River (Italy) basin can be effectively managed are presented. The GIS allows the integration of satellite data provided by various sensors (NOAA-AVHRR (Advanced Very High Resolution Radiometer), LANDSAT Multispectral Scanner, and Thematic Mapper) at different scales. The phenomena studied concern the snow cover changes on Alpine Arch observed at small scale and the crop location in selected areas of the Po plain observed at medium scale. The GIS is used to monitor the effect of the climatic changes in snow cover extension and to determine the environmental impact of the agrotechnologies. ESA

N93-23571# Groupement Scientifique de Teledetection de Strasbourg (France). Inst. of Geography.
PROTOTYPE FOR A REGIONAL DATA MANAGEMENT SYSTEM, A STEP TOWARDS A REGIONAL LAND USE PROJECT
Christiane Weber, Jacky Hirsch, and Aziz Serradj (Rennes Univ., France.) *In* ESA, Environment Observation and Climate Modelling Through

International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 375-376 (For primary document see N93-23507 08-43)
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The increase of human impact on environment is discussed and the identification through inheritance process of land use is addressed. High technology capacities allow progress in the diffusion of accurate information for decision makers. Dealing with a large set of images, the design of a prototype conceived in the knowledge process and manipulation rules is reported. The inheritage issued from images but also from the skill, have to be formalized in order to improve the quality control of land use, land cover analysis. It represents an interesting advance in gain of accuracy and information consistency and also in processing time consuming. ESA

N93-23572# Polish Academy of Sciences, Warsaw. Remote Sensing and Spatial Information Center.
USE OF SATELLITE DATA AND GIS FOR EVALUATING URBAN ENVIRONMENT
Zbigniew Bochenek and Zenon Polawski *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 377-379 (For primary document see N93-23507 08-43)
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An approach using satellite and conventional data integrated within geographic information system for assessing state of urban environment is presented. LANDSAT Thematic Mapper images were the source of remotely sensed information. Three maps were derived from these images and integrated with the digital maps formed from cartographic materials and statistical data. GIS (Geographic Information System) functions of the ERDAS system were utiized to apply a model for environmental hazard assessment within the Warsaw (Poland) area. ESA

N93-23573# Bonn Univ. (Germany). Dept. of Physical Geography.
VEGETATION MAPPING AND A STATISTICAL APPROACH FOR THE RECONSTRUCTION OF THE POTENTIAL FOREST COVER USING LANDSAT-5-TM-DATA AND DTM
G. Braun and M. Winiger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 381-385 (For primary document see N93-23507 08-43)
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Research on the actual vegetation and the potential forest inventory of the semi arid high mountain landscape of the Karakorum mountains (northern Pakistan), from an ecoclimatological point of view, is presented. The distribution of natural vegetation of the Karakorum mountains is characterized by a distinct altitudinal zonation differentiated by slope aspect. From desert steppes in the dry valley bottoms up to most forest belts and alpine meadows the whole vegetation is exposed to an increasing pressure by human activities like logging and grazing. Research is focused on mapping the spatial arrangement of the actual vegetation by field survey and satellite data processing, aligned with modeling the potential forest distribution from relict stands. The major objective is to quantify the decline of natural forest stands by comparing the actual forest pattern with potential forest distribution. The spatial arrangement of forest extracted from the digital vegetation map and DTM (Digital Terrain Model) can be plotted in a multidimensional space of topographic variables. This provides information about the potential relief related boundaries of the forest formation. Statistical analysis using probability and distance functions allow the empirical reconstruction of the potential forest cover. ESA

N93-23574# Academy of Sciences, Ulan Bator (Mongolia). Center of Informatics.
AN APPLICATION OF REMOTE SENSING AND GIS TECHNIQUE IN MONGOLIA (ON THE EXAMPLE OF EXPERIMENT GEOMON-1990)
M. Ganzorig, D. Amarsaihan, and B. Enkhtuvshin *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 387-390 (For primary document see N93-23507 08-43)
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In 1990 one of the steps of the international airspace experiment 'GEOMON-90' was carried out on Mongolian territory within the framework of the scientific project 'research of the dynamics of geosystems by methods of remote sensing of the 'INTERCOSMOS' program and was intended for the investigation of the modern conditions of the Mongolian steppe geosystem. Some results of the processing and interpretation of the experimental data and applied techniques of remote sensing and GIS (Geographic Information System) using the digital image processing system ERDAS are presented. ESA

N93-23575# Technische Univ., Munich (Germany). Photogrammetry and Remote Sensing.
INTEGRATION OF DIGITAL IMAGE MATCHING AND MULTI IMAGE SHAPE FROM SHADING
C. Heipke *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 391-400 (For primary document see N93-23507 08-43)
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An approach integrating digital image matching and multi image SFS (Shape From Shading) in object space is presented. In a least squares adjustment the unknowns (geometric and radiometric parameters of the object surface) are estimated from the pixel intensity values and control information. The perspective projection is used for the transformation from object to image space. The approach is investigated using synthetic images. The main results are the following: heights of a digital terrain model instead of terrain slopes can be calculated directly using multi imager SFS alone or the combined approach; there is no need for conjugate points in the multi image SFS approach (this is especially important since in weakly textured images the correspondence problem is extremely hard to solve due to the lack of image intensity gradients); if variable albedo is present in parts of the object surface only the combined approach yields correct results (multi image SFS and digital image matching alone fail in this case). ESA

N93-23576# Consiglio Nazionale delle Ricerche, Bari (Italy). Ist. Elaborazione Segnali ed Immagini.
LAND USE MAPPING FROM MULTITEMPORAL SATELLITE IMAGES AND ANCILLARY DATA, USING A NEURAL NETWORK PARADIGM
G. Pasquariello and P. Blonda *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 401-406 Sponsored by Italian Space Agency (For primary document see N93-23507 08-43)
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Work to compare the performance of a Neural Network (NN) classifier with a Maximum Likelihood (ML) one when applied to remote sensed multiband images, both in the case of a single date set and a multitemporal composite image, is presented. The comparison was extended to the case where the input data are obtained integrating a satellite image with non remote sensed data, such as digital elevation data. For these three different experimental situations, the overall classification accuracy was evaluated both for NN and ML, comparing the difference in performance on training and test data sets. The results obtained with the two different approaches were related to the statistical measure of the separability on the input data. ESA

N93-23577# Augsburg Univ. (Germany). Didactics of Geography.
VALENCY OF DIFFERENT INFORMATION CATEGORIES AND ITS IMPORTANCE FOR THE EFFECTIVENESS OF IMAGE ANALYSIS BY THE VISUAL SYSTEM AND AUTOMATIC SYSTEMS
U. Wieczorek *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 407-411 (For primary document see N93-23507 08-43)
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The valency of the different image information categories 'density', 'contour' and 'texture', is calculated. These valencies are important for the estimation of the effectiveness of image interpretation with the aid of the human visual system or with the aid of methods of automatic image processing and analysis. ESA

N93-23578# Technische Univ., Berlin (Germany). Inst. fuer Geologie-Geoinformatik.

ANALYSIS OF HUMAN IMPACT ON DEGRADATION AND DESERTIFICATION OF THE WEST AFRICAN SAHEL BY MEANS OF MULTI-LEVEL REMOTE SENSING TECHNIQUES **c45**

E. Csaplovics *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 413-416 (For primary document see N93-23507 08-43)

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The synthesis of three levels of remote sensing, of in situ derived spectral signatures of trees and shrubs, of detailed vegetation structure interpretation (aerial photography) and of classification on vegetation functional types and units of regional landcover (satellite images) describes an important way of modeling integrated systems of degradation and desertification monitoring of destabilized Sahelian regions. Human impact on vegetation layers of former Südano-Sahelian grasslands is the main reason for these destructive phenomena. The regional distribution and multitemporal dynamics of impact patterns are analyzed by using multistage remote sensing techniques and image interpretation. Monitoring and mapping land use and land cover is a tool for planning restoration of degradated areas. ESA

N93-23579# Computer Graphics Center, Darmstadt (Germany).

THE ANALYSIS OF REMOTELY SENSED DATA WITH NEURAL NETWORKS

A. Stork, M. Gross, and S. Saradeth (Gesellschaft fuer Angewandte Fernerkundung, Munich, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 417-422 (For primary document see N93-23507 08-43)

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The application of Artificial Neural Networks (ANN) towards the supervised classification of multispectral satellite data is described. A direct comparison with the maximum likelihood classifier is performed. The ANN is implemented as a multilayer perceptron and trained by the backpropagation algorithm. Two LANDSAT Thematic Mapper scenes covering the district of Niederbayern (Germany) and extensive ground truth form the basis for this approach. Confusion matrices are used to compare the results of the classification process. In addition the generalization capabilities of ANN are demonstrated. ESA

N93-23580# Cagliari Univ. (Italy). Dipt. di Scienze della Terra.

TM-SPOT MULTITEMPORAL ANALYSIS ON AREAS DEVASTED BY FIRE

A. Marini and M. T. Melis *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 423-425 (For primary document see N93-23507 08-43)

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The analysis of a three year series of SPOT images of Sardinia is reported. The series helped to calibrate the methodology in order to identify changes in land use and map the precise evolution of single force foci that at times develop into episodes involving more than 5000 hectares. Recognition of burnt areas in SPOT and LANDSAT Thematic Mapper (TM) images at the end of the Summer season is much simpler than distinguishing between land parched by the Sun and surfaces devastated by Spring fires. In order to cross check with data from the fire fighting intervention of the last three years, vegetation classes need to be recognized in order to locate possible changes in land use. ESA

N93-23581# Telespazio, S.p.A., Rome (Italy). Earth Observation Dept.

MICROSCALE GEOMORPHOLOGICAL ANALYSIS IN MIDDLE ITALY USING AIRBORNE AND SATELLITE REMOTE SENSING TECHNIQUES

Guido Boarelli, Pasquale Lanciano, Claudio Margottini (Ernest F. Fullam, Inc., Schenectady, NY.), and Alessandro Cacciarini (Cacciarini, Alessandro, Florence, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 427-432 (For primary document see N93-23507 08-43)

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An investigation of the possibility of using methodologies based on remote sensing techniques to monitor areas which present rapid erosion phenomena is reported. As test zone, the ancient medieval town of Civita di Bagnoregio, in the middle of Italy, was chosen, due to the fact that the problems connected to hydrogeologic erosion there assume accelerated and very evident typologies. Thanks to aerial photos and to LANDSAT Thematic Mapper and SPOT satellite scenes, it was possible to investigate the morphologic evolution of the area within a period of about 35 years. The contribution of that analysis was fundamental to understand the environmental dynamics acting there and to plan projects to safeguard an important historical town. ESA

N93-23582# Politecnico di Milano (Italy). Sezione di Rilevamento.

THE CREATION OF A DEM FROM SPOT DATA

B. Crippa, A. deHaan, and L. Mussio *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 433-438 Sponsored by Aeronautica Militare Italiana (For primary document see N93-23507 08-43)

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An approach to automated DEM (Digital Elevation Model) production from SPOT imagery is presented. In a three step procedure, aerotriangulation is carried out to precisely determine the imaging geometry, a mathematical model based on this is used for obtaining maximum precision with a minimum of ground control, and a large number of conjugate image points is measured automatically and with the obtained pairs of image coordinates the corresponding terrain positions are computed. Feature driven least squared matching is used in a multiresolution procedure. The terrain surface is reconstructed from the point data by the fitting of a bicubic spline function. ESA

N93-23583# Zurich Univ. (Switzerland). Remote Sensing Labs.

REALISTIC LANDSCAPE VISUALIZATION BASED ON SATELLITE IMAGES

K. C. Graf, J. Hagger, E. Meier, D. Nueesch, and M. Suter *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 439-443 (For primary document see N93-23507 08-43)

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Efforts undertaken in the field of perspective visualization of natural landsapes using Digital Elevation Model (DEM) and satellite images are presented. The principal goal is an image simulation with a high degree of realism. After an appropriate preprocessing including radiometric corrections and image enhancement procedures, a geometric correction is executed in order to achieve a very high co-registration with the terrain model. The mosaic of several satellite images is stored together with the DEM in a data base covering an extensive area. A projection software allows the user to specify all interior and exterior orientation parameters of a virtual camera to compute any perspective scenes. To obtain more realism atmospheric effects can be simulated. The achieved results show that this technology can be used in the field of environmental planning, civil engineering and in many other domains where terrain visualization is required. ESA

N93-23584# Mullard Space Science Lab., Dorking (England).

THE COMPARISON OF SATELLITE RADAR ALTIMETER DERIVED HEIGHTS WITH GLOBAL DIGITAL TERRAIN MODEL HEIGHTS

J. K. Ridley, P. A. M. Berry (VEGA Space Systems Engineering Ltd.,

Harpenden, England.), C. M. Birkett, and C. G. Rapley *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 445-450 (For primary document see N93-23507 08-43)

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A study of the use of SEASAT and Geosat altimeter data for global height determination is reported. Currently available Global Digital Elevation Models (GDEMs) are of limited spatial resolution and accuracy, while satellite altimetry offers the prospects of global coverage of heights with relation to a single reference datum. A global comparison of elevation values derived from satellite altimetry data with those of existing ground based GDEMs is presented. Whilst the coverage of past radar altimeters is such that mean heights can only be generated for about 10 percent of the along track surface, which represents a sampling of only about 1 percent of the world land surface, these data permit a quantitative assessment to be made of GDEM accuracy. The results demonstrate that the planned 176 day repeat of ERS-1 will have the capability to produce an altimeter derived GDEM referenced to a single height datum. ESA

N93-23585# Technische Univ., Munich (Germany). Photogrammetry and Remote Sensing.

THE PROMISE OF RASTER DATA PROCESSING IN DIGITAL TERRAIN MODELLING

L. Tang *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 451-457 (For primary document see N93-23507 08-43)

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Two approaches based on raster data processing techniques for solving problems in digital terrain modeling are presented: the raster based triangulation, which allows for a simple consideration of constraint edges; and the medial axis approach for automatically deriving geomorphological elements, for example peaks, pits, saddle points, ridge and drainage lines, from a given set of contours. Using both the given contours and the derived geomorphological elements a high quality digital terrain model can be obtained. Practical examples are given. The achieved results show that the use of raster data processing techniques for digital terrain modeling is promising. ESA

N93-23586# MATRA Marconi Space (England).

FEATURE DETECTION USING ERS-1 SAR DATA

F. G. Sawyer and D. C. Lancashire *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 459-464 (For primary document see N93-23507 08-43)

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The launch of ERS-1 provides a new opportunity for the exploitation of space based remote sensing. Synthetic Aperture Radar (SAR) provides all weather coverage of the Earth's surface and means that applications requiring the timely delivery of data or information may now be considered. One such application is to detect and monitor shipping. Others are for mapping of sea/ice, pollution monitoring or any application which necessitates imaging routinely or even on a particular day. It is recognized that ERS-1, although limited in the coverage offered, provides a first chance to demonstrate some of these applications. An example of this is given by the SAR Feature Extraction System (SIFES) workstation. The use of radar data requires new algorithms and techniques to those familiar from processing optical data. Targets imaged from ERS-1 appear very different to those imaged from SPOT or LANDSAT. Some of the effects noticeable within SAR imagery and the implications for this in the ground processing chain and in particular the image processing algorithms are discussed. ESA

N93-23668# Army Topographic Engineering Center, Fort Belvoir, VA.

WATER REGIONS EXTRACTION FROM RADAR IMAGERY USING A NEURAL NETWORK

Tho Con Tran and Pi-Fuay Chen 16 Dec. 1992 5 p (AD-A259517) Avail: CASI HC A01/MF A01

An artificial neural network concept is explored and developed for detecting and extracting water regions from radar imagery. A backpropagation neural network consisting of three layers of processing elements (PE's) is selected for this application. The input layer is composed of nine PE's that are arranged to process a single pixel at the same time. Two PE's in a hidden layer are sufficient for delineating water from other terrain categories. A single output PE with a thresholding function classify effectively all test images into two terrain categories: water and non-water. Large-scale Synthetic Aperture Radar (SAR) images, containing 512 by 512 pixels, were used as the test images for this experiment. Two blocks of water regions totalling 2,048 pixels were extracted for training the network. All the water pixels were classified correctly, while more than 99 percent of the non-water pixels were correctly classified. GRA

N93-23737*# National Aeronautics and Space Administration, Washington, DC.

1993 EARTH OBSERVING SYSTEM REFERENCE HANDBOOK

Ghassem Asrar, ed. and David Jon Dokken, ed. Mar. 1993 143 p (NASA-NP-202; NAS 1.83:202) Avail: CASI HC A07/MF A02

Mission to Planet Earth (MTPE) is a NASA-sponsored concept that uses space- and ground-based measurement systems to provide the scientific basis for understanding global change. The space-based components of MTPE will provide a constellation of satellites to monitor the Earth from space. Sustained observations will allow researchers to monitor climate variables overtime to determine trends; however, space-based monitoring alone is not sufficient. A comprehensive data and information system, a community of scientists performing research with the data acquired, and extensive ground campaigns are all important components. Brief descriptions of the various elements that comprise the overall mission are provided. The Earth Observing System (EOS) - a series of polar-orbiting and low-inclination satellites for long-term global observations of the land surface, biosphere, solid Earth, atmosphere, and oceans - is the centerpiece of MTPE. The elements comprising the EOS mission are described in detail. CASI

N93-23748# European Space Agency, Paris (France).

ENVIRONMENT OBSERVATION AND CLIMATE MODELLING THROUGH INTERNATIONAL SPACE PROJECTS. VOLUME 3: EARTH OBSERVATION SPACE PROGRAMMES, SAFISY ACTIVITIES, STRATEGIES OF INTERNATIONAL ORGANISATIONS, LEGAL ASPECTS

T. Duc Guyenne, ed. and James J. Hunt, ed. 1992 522 p In ENGLISH and FRENCH Conference held in Munich, Germany, 30 Mar. - 4 Apr. 1992; sponsored by EEC, ESA, Deutsche Agentur fuer Raumfahtangelegenheiten, and the European Association for the International Space Year

(ESA-ISY-1-Vol-3; ETN-93-93504) Copyright Avail: CASI HC A22/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The conference theme was the practical use of space derived information for environmental research and monitoring, and resource management. The topics covered by the presented papers include the following: international Earth observation projects and international collaboration; the ERS-1 program; the SPOT program; the Priroda program; Earth observation research programs and concept synergies; the 1st ESA Earth observation polar platform and its payload; future Earth observation remote sensing techniques and concepts; SAFISY (Space Agency Forum for the ISY) activities; program and strategies of international organizations with respect to earth observation from space; and legal aspects of the use of satellite remote sensing data in Europe. For individual titles, see N93-23749 through N93-23855.

N93-23749*# National Aeronautics and Space Administration, Washington, DC.

THE EARTH OBSERVING SYSTEM

Lisa Robock Shaffer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 945-950 (For primary document see N93-23748 08-43)

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The restructuring of the NASA Earth Observing System (EOS), designed to provide comprehensive long term observations from space of changes occurring on the Earth from natural and human causes in order to have a sound scientific basis for policy decisions on protection of the future, is reported. In response to several factors, the original program approved in the fiscal year 1991 budget was restructured and somewhat reduced in scope. The resulting program uses three different sized launch vehicles to put six different spacecraft in orbit in the first phase, followed by two replacement launches for each of five of the six satellites to maintain a long term observing capability to meet the needs of global climate change research and other science objectives. The EOS system, including the space observatories, the data and information system, and the interdisciplinary global change research effort, are approved and proceeding. Elements of EOS are already in place, such as the research investigations and initial data system capabilities. The flights of precursor satellite and Shuttle missions, the ongoing data analysis, and the evolutionary enhancements to the integrated Earth science data management capabilities are all important building blocks to the full EOS program. ESA

N93-23750*# National Aeronautics and Space Administration, Washington, DC.

NASA'S UPPER ATMOSPHERE RESEARCH SATELLITE: A PROGRAM TO STUDY GLOBAL OZONE CHANGE

Michael R. Luther *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 951-958 (For primary document see N93-23748 08-43)

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The Upper Atmosphere Research Satellite (UARS) is a major initiative in the NASA Office of Space Science and Applications, and is the prototype for NASA's Earth Observing System (EOS) planned for launch in the 1990s. The UARS combines a balanced program of experimental and theoretical investigations to perform diagnostic studies, qualitative model analysis, and quantitative measurements and comparative studies of the upper atmosphere. UARS provides theoretical and experimental investigations which pursue four specific research topics: atmospheric energy budget, chemistry, dynamics, and coupling processes. An international cadre of investigators was assembled by NASA to accomplish those scientific objectives. The observatory, its complement of ten state of the art instruments, and the ground system are nearing flight readiness. The timely UARS program will play a major role in providing data to understand the complex physical and chemical processes occurring in the upper atmosphere and answering many questions regarding the health of the ozone layer. ESA

N93-23751# National Space Development Agency, Tokyo (Japan). Program Planning and Management Dept.

NASDA'S EARTH OBSERVATION SATELLITE PROGRAM

Shuichi Miura *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 959-960 (For primary document see N93-23748 08-43)

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The past and near future of the NASDA (National Space Development Agency of Japan) Earth observation satellite program are summarized: MOS-1 (Marine Observation Satellite), JERS-1 (Japanese Earth Resources Satellite), GMS-5 (Geostationary Meteorological Satellite), ADEOS (Advanced Earth Observing Satellite), TRMM (Tropical Rain Measuring Mission), and ADEOS 2. These satellites bring massive data to the ground stations, and it is recognized as important that these data should be archived and processed appropriately, and be utilized by scientists through the worldwide data access network. ESA

N93-23752# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany).

METEOSAT OPERATIONAL PROGRAMME CURRENT MISSIONS AND SERVICES

M. G. Phillips *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 961-965 (For primary document see N93-23748 08-43)

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An outine of EUMETSAT, the independent intergovernmental organization of 16 European states, now responsible for the continuation of the Meteosat Operational Program (MOP), and missions and services of MOP are presented. The space and ground segments, the spacecraft, and image acquisition and dissemination are described. The Data Collection System (DCS) and Meteorological Data Distribution (MDD) supported by Meteosat are outlined. The combination of four of the Meteosat missions by the user to provide a cost effective integrated meteorological data access system known as Meteosat Operational System for data Acquisition and Interchange (MOSAIC) is described. The extraction of meteorological products and meteosat data archiving are described. The role of Meteosat and other weather satellites in international cooperation is discussed. ESA

N93-23753# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany).

METEOSAT SECOND GENERATION: A LOOK TO THE FUTURE

Francois Gerard *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 967-972 (For primary document see N93-23748 08-43)

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The status of definition of the Meteosat Second Generation (MSG) satellite system is described. Starting with a short history of the evolution of the requirements during the last decade, the characteristics of the future European geostationary imaging radiometer, known as the Spinning Enhanced Visible and InfraRed Imager (SEVIRI), are described. Special attention is given to the coherence of this instrument with those to be flown on the polar orbiting platforms. In conclusion, an overview of the MSG development phases is given, with emphasis on the need for the preparation of MSG operation by developing a synthetic image simulation program enabling scientists to test applications prior to the first launch. ESA

N93-23754# National Oceanic and Atmospheric Administration, Washington, DC. Data and Information Service.

COOPERATION WITH EUROPE IN NOAA OPERATIONAL SATELLITE PROGRAMS

Russell Koffler, Bruce Needham, and Stanley Schneider *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 973-974 (For primary document see N93-23748 08-43)

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The contributions to the U.S. polar program by NOAA's European partners in the form of operational sensors and systems and, with regard to future programs, the assumption by Europe of the role of providing spacecraft to fly the morning polar mission are discussed. For the geostationary program, cooperative efforts between the U.S. and Europe in the GOES and Meteosat programs are discussed and the present arrangement between NOAA, ESA, and EUMETSAT for use of Meteosat 3 as a GOES backup is outlined. ESA

N93-23755# Alfred-Wegener-Inst. for Polar Research, Bremerhaven (Germany). Nationales Global Change Sekretariat.

SATELLITE-BORNE EARTH OBSERVATIONS IN THE FRAMEWORK OF GERMAN GLOBAL CHANGE RESEARCH

M. A. Lange and B. Rami (Bundesministerium fuer Forschung und

Technologie, Bonn, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 975-977 (For primary document see N93-23748 08-43)

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A description of the German components of international global change research and the associated needs for global environmental data to be provided by remote sensing platforms is presented. Changes in the Earth's environment, mainly caused by human activities during the last hundred years call for efficient political countermeasures. These, however, have to be based on sound and reliable scientific investigations and predictions of the future course of our globe. The scientific community has responded to this challenge through a number of recently implemented international global change research projects. Germany has from the onset and will continue to play an active part in these projects. One of the prerequisites of these investigations is the need for long term, continuous observations of Earth system parameters, which cover our entire planet. Satellite-borne remote sensing projects provide the most promising means of fulfilling this requirement. Within German global change research, remote sensing therefore plays an essential role. This role is being realized through a number of national projects as well as through cooperation on the European and the international level. ESA

N93-23756# Italian Space Agency, Matera.

ITALIAN SPACE AGENCY ACTIVITIES IN EARTH OBSERVATION

G. Bianco, L. DeFusco (Italian Space Agency, Rome.), G. Milillo, and G. Sylos-Labini *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 979-981 (For primary document see N93-23748 08-43)

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The Italian space agency (ASI) activities in Earth observation range from ground segment application to planetary exploration activities. These activities are both in national and bilateral cooperation programs as well as in the framework of the Italian participation to ESA. The ASI/NASA Lageos 2-Iris complex, to be launched in 1992, will be the precursor of several ASI efforts devoted to Earth observation. Several missions and development carried out by ASI are addressed. Besides the effort on space segment, ASI had several ongoing activities in precursor airborne demonstration flights, and ground infrastructure development, science and utilization projects. These activities are carried out in close relationship with the national aerospace industry, the Italian science community, and with the main foreign space authority. In this framework, an ASI contribution in the International Space Year activities for natural disaster monitoring and prediction is foreseen. A description of the capabilities of ASI's main ground facility, the ASI center for space geodesy, is given. ESA

N93-23757# Dornier System G.m.b.H., Friedrichshafen (Germany).

ERS-1: THE FIRST EUROPEAN EARTH OBSERVATION SYSTEM

Alfred Setzer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 983-990 (For primary document see N93-23748 08-43)

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The ERS-1 mission, mainly dedicated to ocean and ice application is reported. The ERS-1 system, and 'end to end' system for all weather and global environmental monitoring, is described. The program development from first studies to launch is outlined. Numerous pictures were taken by the onboard SAR (Synthetic Aperture Radar) instrument irregardless of daytime and cloud coverage, thus demonstrating its all-weather capability. The accuracy/resolution of approximately 25 m is better than originally specified. Spectacular results were achieved through multi-image processing, thus gaining information about changes which occurred during a given time period or longer term ice observation. The system also demonstrated its capability to observe oil slicks and pollution of the oceans. The global aspect and usefulness of the radar altimeter and scatterometer measurements were well demonstrated, and the data are already now being fed into the various meteorological services to assist in increasing the long term weather forecast and to assist in climate modeling. ATSR (Along Track Scanning Radiometer) data on sea surface temperature, water vapor content etc., being of high importance for climate and ocean circulation observation, were obtained both regionally and globally with an outstanding accuracy. Pilot projects and program continuation are outlined. ESA

N93-23758# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications-Advanced Technologies Inst.

A STRATEGY FOR MONITORING THE TROPICAL FOREST WITH ERS-1 SAR IMAGERY

H. DeGroof, A. J. Sieber, A. Sowter (VEGA Space Systems Engineering Ltd., Harpenden, England.), and J. Conway (National Remote Sensing Centre, Farnborough, England.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 991-995 (For primary document see N93-23748 08-43)

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Strategy concepts related to the use of ERS-1 SAR (Synthetic Aperture Radar) imagery for monitoring the tropical forest ecosystem are presented. The feasibility of both a worldwide and a 'hot spot' monitoring approach is discussed. A data processing strategy is presented with references to first results on case studies carried out on ERS-1 SAR data collected during the first months of the ERS-1 mission. Conclusions relating to the following are discussed: even at coarse resolution, the potential separability of the forest/non forest areas is seen; expansion of the ground receiving stations is of utmost importance; the hot point strategy is desirable for efficient information handling; and a worldwide information system should be initiated. ESA

N93-23759# Nansen Remote Sensing Center, Bergen (Norway).

ERS-1 SAR ICE ROUTING OF L'ASTROLABE THROUGH THE NORTHEAST PASSAGE

O. M. Johannessen, S. Sandven, O. Skagseth, K. Kloster, Z. Kovacs, P. Sauvadet (Mers Magnetique, France.), L. Geli (Mers Magnetique, France.), W. Weeks (Alaska Univ., Fairbanks.), and J. Louet (European Space Agency, Paris, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 997-1002 Sponsored by NASA, ERS-1 Mission Manager, ESA, and Norwegian Space Center (For primary document see N93-23748 08-43)

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The use of Synthetic Aperture Radar (SAR) data from the satellite ERS-1 to assist the French polar vessel 'L'Astrolabe' during its navigation through Artic sea ice in the Northeast Passage is reported. The ship spent one month on the voyage from Europe to Japan, and high resolution SAR images and ice maps based on SAR images from ERS-1 and Special Sensor Microwave/Imager were telefaxed to the ship using the Inmarsat system. The time delay from observation to the reception of SAR images aboard the ship varied from 6 hours to two days. The quality of these ice maps was compared with Russian ice maps and observations from the ship. The SAR imagery provided detailed information on ice floe distribution, ice concentration, ice types, open leads, and tracks in ice from icebreakers. The response from the Russian ice specialists on the quality of the SAR ice maps was very positive. ESA

N93-23760# Nansen Remote Sensing Center, Bergen (Norway).

COASTAL OCEAN STUDIES WITH ERS-1 SAR DURING NORCSEX 1991

J. A. Johannessen, R. A. Shuchman (Environmental Research Inst. of Michigan, Ann Arbor.), K. Davidson (Naval Postgraduate School, Monterey, CA.), O. Frette, R. Onstott (Environmental Research Inst. of Michigan, Ann Arbor.), and O. M. Johannessen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1003-1007 Sponsored by Norwegian Space Center, Bergen Univ., ESA, Operatoerkomite Nord,

and Oceanographer of the Navy, US (For primary document see N93-23748 08-43)
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The Norwegian Continental Shelf Experiment-NORCSEX'91 was conducted between 6-29 Nov. 1991 during the commissioning phase of ERS-1. In this period, about 30 SAR (Synthetic Aperture Radar) scenes were obtained at a regular interval of three days and complemented with in situ observations of wind-wave-current and their interaction collected from ship and moorings. The integrated data base reveals that SAR images document expressions of: mesoscale ocean current circulation pattern including frontal boundaries and eddies; wave-current refraction; internal waves; and rapid mesoscale wind field variations. In some cases, impacts of radar imaging geometry on these image expressions are found. In addition, the expressions of oceanic circulation features are limited by both high and low wind speed. These preminminary results are presented and discussed. ESA

N93-23761# Technical Research Centre of Finland, Espoo.
DEMONSTRATION OF ERS-1 SAR SEA ICE MAPPING IN THE BALTIC SEA
Einar-Arne Herland and Robin Berglund *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1009-1013 (For primary document see N93-23748 08-43)
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The processing and transmission of SAR (Synthetic Aperture Radar) images is reported. Marine traffic in the northern Baltic is severely affected by ice for several months during the winter. The Ice Service regularly compiles and issues ice charts, and the Finnish Board of Navigation maintains a fleet of icebreakers that keep harbors open and aid ship traffic. The demonstration experiment received ERS-1 SAR fast delivery images in Helsinki during the period Jan. - Mar. 1992. These images were preprocessed, geometrically rectified, and transmitted to the Ice Service and the icebreaker fleet, which also received NOAA images, where a workstation is used by the crew for viewing and interpreting the images. The transmission channels used in the experiment, the processing done to the images and the workstation are described. Experiences gathered and problems encountered in the experiment are described. ESA

N93-23762# Ice Centre Environment Canada, Ottawa (Ontario).
EARLY RESULTS ON THE USE OF ERS-1 SAR DATA FOR REAL-TIME SEA ICE MONITORING IN CANADIAN WATERS
Bruce R. Ramsay and Rodney Duncan (Waterloo Univ., Ontario.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1015-1017 (For primary document see N93-23748 08-43)
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A summary of ERS-1 SAR (Synthetic Aperture Radar) data capture, transfer, and processing for sea ice monitoring in Canada is given. Ice Center Environment Canada (ICEC) will be receiving up to 20 ERS-1 SAR images per day from the SAR data processing facility. This data will be transmitted in real time by means of a dedicated digital link at T1 data rates (1.544 Mbits/sec). The data will be subsequently captured, processed, and displayed by the Ice Data Integration and Analysis System (IDIAS) and integrated with other data into ice products for marine clients. SAR enhancement and analysis techniques are discussed. Examples of ERS-1 scenes of the ice regime off the Canadian east coast are shown and related to the data sets. ESA

N93-23763# European Centre for Medium-Range Weather Forecasts, Reading (England).
ERS-1 SCATTEROMETER CALIBRATION AND VALIDATION ACTIVITIES AT ECMWF. A: THE QUALITY AND CHARACTERISTICS OF THE RADAR BACKSCATTER MEASUREMENTS
Ad Stoffelen and David L. T. Anderson (Oxford Univ., England.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1019-1024 (For primary document see N93-23748 08-43)
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Calibration and validation activities for the ERS-1 scatterometer were carried out at ECMWF (European Centre for Medium range Weather Forecasting), complementary to the 'Haltenbanken' field campaign off the coast of Norway. At a Numerical Weather Prediction (NWP) center, a wealth of verifying data is available both in time and space. By using the data and resources available at a NWP center, it is possible to contribute extensively to a satellite instrument calibration and validation exercise. Noise was estimated and scatterometer measurements were characterized in relation to wind speed and direction. The antennae configuration of the ERS-1 scatterometer proved to be crucial for this work. It is shown that a solution plane is well defined in three dimensional measurement space and measurement noise is low. ESA's transfer model CMOD2 has to be extensively reformulated. ESA

N93-23764# European Centre for Medium-Range Weather Forecasts, Reading (England).
ERS-1 SCATTEROMETER CALIBRATION AND VALIDATION ACTIVITIES AT ECMWF. B: FROM RADAR BACKSCATTER CHARACTERISTICS TO WIND VECTOR SOLUTIONS
Ad Stoffelen, David L. T. Anderson (Oxford Univ., England.), and Peter M. Woiceshyn (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1025-1029 (For primary document see N93-23748 08-43)
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Calibration and validation activities for the ERS-1 scatterometer were carried out at ECMWF (European Center for Medium range Weather Forecast) complementary to the 'Haltenbanken' field campaign off the coast of Norway. At a Numerical Weather Prediction (NWP) center a wealth of verifying data is available both in time and space. This data is used to redefine the wind retrieval procedure given the instrumental characteristics. It was found that a maximum likelihood estimation procedure to obtain the coefficients of a reformulated sigma deg to wind relationship should use radar measurements in logarithmic rather than physical space, and use winds as the wind components rather than wind speed and direction. Doing this, a much more accurate transfer function than the one currently operated by ESA was derived. Sigma deg measurement space shows no signature of a separation in an upwind solution cone and a downwind solution cone. As such signature was anticipated in ESA's wind direction ambiguity removal algorithm, reconsideration of the procedure is necessary. Despite the fact that revisions have to be made in the process of wind retrieval; a grid potential is shown for scatterometry in meteorology and climatology. ESA

N93-23765# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany).
OPERATIONAL GEOCODING OF ERS-1 SAR IMAGERY
Gunter Schreier and Achim Roth *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1031-1036 (For primary document see N93-23748 08-43)
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An introduction to the ERS-1 is given and the definition of SAR (Synthetic Aperture Radar) geocoded products and their applicability is explained. Basic image geolocation without any further external reference data is performed at the German Processing and Archiving Facility (D-PAF) for ERS-1 on an operational basis. Higher level geocoded data, which include the correction of terrain distortions are also generated. To produce this kind of data, geocoded reference data sets, such as digital elevation models, topographic maps, and automatically derived tiepoints must be archived and accessed. The corresponding data bases and processing algorithms were developed in order to serve the production of terrain corrected products. The entire geocoding of SAR and treatment of reference data is performed on UNIX workstations. The software is written in a

modular fashion to allow possible extensions and the geocoding of other spaceborne SAR missions. Therefore, the D-PAF GEOS for ERS-1 is intended to be a basis for further higher level SAR derived geophysical products, such as SAR interferometry and operational ice floe tracking.
ESA

N93-23766# Centre National d'Etudes Spatiales, Toulouse (France).
THE SPOT PROGRAM
Yves Trempat *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1037-1039 (For primary document see N93-23748 08-43)
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The general status of the SPOT program, an optical Earth observation satellite system giving permanent data source for geographic information, land use, urban planning, and agriculture applications, is described. It is also a tool for local environment issue studies such as deforestation, coastal zone evolutions, urban pressions, evaluation of impacts of civil engineering constructions, etc. It offers the following main features: high resolution, 10 and 20 m; stereo coverage capability offering terrain modeling capability; and high revisit capability. SPOT 1, 2, 3, and 4 are described. Passengers for different missions and experiments on SPOT 4 and the vegetation instrument are described. The high resolution ground optical mission and synthetic aperture radar mission follow on programs are outlined.
ESA

N93-23767# Centre National d'Etudes Spatiales, Toulouse (France).
THE SPOT 4 SATELLITE AND BEYOND
Michel Arnaud and Claude Fratter *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1041-1047 (For primary document see N93-23748 08-43)
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The SPOT 4 satellite to extend the high resolution mission through the addition of a new band in the middle infrared region and to extend the life duration is reported. This satellite will embark new passengers and function mainly as a terminal to experiment optical link between a low orbiting satellite (SPOT) and a geostationary satellite. Very high resolution and along track stereoscopic mission are under development, beyond SPOT 4, to satisfy the user needs to maintain and to improve the continuity of the SPOT services.
ESA

N93-23768# Centre National d'Etudes Spatiales, Toulouse (France).
SPOT 4 IMAGE GROUND SEGMENT
Gilbert Pauc *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1049-1052 (For primary document see N93-23748 08-43)
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The development of a ground segment for SPOT 4, compatible with that for SPOT 1, 2, and 3, to be put into service as soon as it is operational, is reported. The ground segment consists of a programming center, a stationkeeping center, an image ground segment, and a commercial management center. The image ground segment, which aims to take into account the peculiarities of the SPOT 4 satellite, to improve the service and to reduce operating costs, is described. The current Space Imagery Receiving Station (SRIS) is to be altered, principally for the replacement of linear recorder by cassette recorder and for the automation of management and communication. A new PASTEL image receiving station is to be used only by SPOT 4, which will fly the experimental optical communication system known as PASTEL. The archive and preprocessing center, which will only produce system rectified products, is described. The system image quality unit groups together the drawing up and monitoring of parameters needed for preprocessing and the follow up of system image quality. Progress and schedule are outlined.
ESA

N93-23769# Centre National d'Etudes Spatiales, Toulouse (France). Earth Observation Div.
THE SPOT SYSTEM DEVELOPMENT PROGRAM: SPOT AVAL
Veronique Mariette *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1053-1055 (For primary document see N93-23748 08-43)
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The SPOT AVAL program was created in 1987 to speed up the development of operational use of SPOT data. This program concerns three main types of activities: promotion of SPOT data at a national and international level; education, training of users, and transfer technology; and development of new services and products derived from SPOT data. Up to now, this program has allowed the setting up of a network of remote sensing users (trainers, institutionals, engineering and services companies, industrials), the development of a methodological and technical knowhow, and the promotion of technology transfer from research level to operational level. This program will now be more oriented to: the valorization of products, including technology transfer; the consolidation of knowhow with the development of environmental applications; the use of SPOT data within large scale national and international projects; and the integration of SPOT data in geographical information systems.
ESA

N93-23770# Joint Research Centre of the European Communities, Ispra (Italy). Pilot Project for the Application of Remote Sensing to Agricultural Statistics.
ACTION 4 FROM IMAGE TO STATISTICS: OPERATIONAL REVIEW AFTER TWO YEARS OF RAPID ESTIMATES OF ACREAGES AND POTENTIAL YIELDS OF MAJOR ANNUAL CROPS THROUGHOUT THE EUROPEAN COMMUNITY
Martin Sharman and Helene deBoissezon (SCOT Conseil, Ramonville, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1057-1061 (For primary document see N93-23748 08-43)
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The operational implications of the requirements of the Directorate General 4 (DG4) (Agriculture) of the Commission of the European Communities and the Statistical Office of the European Communities (Eurostat), for regular up-to-date information about changes in acreages and potential yields of major annual crops throughout the European Community are examined. The key expressions that describe Action 4, speed, volume, and stable set of sample sites, are demonstrated. The aim of the MARS (Monitoring Agriculture by Remote Sensing) project is to complement and harmonize European agricultural statistics using a range of new methods, notably remote sensing. The phrases remote sensing and Earth observation cover the use of high resolution satellite borne instruments such as SPOT HRV (High Resolution Visible) imaging instruments and LANDSAT Thematic Mappers, as well as low resolution instruments such as the NOAA AVHRR (Advanced Very High Resolution Radiometer). Apart from the SPOT, LANDSAT, and NOAA series, no other civilian spacecraft currently supply remote sensing data on an operational basis. In response to the requirements of DG4 and Eurostat, the MARS project aims to explore the full potential of these data sets.
ESA

N93-23771# Academy of Sciences (USSR), Moscow. Radioengineering and Electronics Inst.
THE SCIENTIFIC PROGRAM OF THE PRIRODA PROJECT
N. Armand, B. Kutuza, and V. Panchenko (Energia, Inc., Moscow, Russia.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1063-1066 (For primary document see N93-23748 08-43)
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The international space project Priroda is described. Priroda is designed to perform remote sensing of the Earth. Experiments on this project are

planned to be fulfilled in 1993-1995 by a special module which will be joined to the Mir orbital station. The instrumental complex of the module includes active and passive remote sensing instruments for microwave, infrared, and visible regions of electromagnetic waves. Most of the Priroda experiments have research and methodic character, some of them are of practical interest. The scientific program consists of land, sea surface, and atmospheric exploration, and ecological research. ESA

N93-23772# Academy of Sciences (USSR), Moscow. Geography Inst.
EVALUATION OF GEOSYSTEM DYNAMICS AND THEIR SPATIAL STRUCTURE BENCHMARK FOR PRIRODA
L. Vasiliev *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1067-1072 (For primary document see N93-23748 08-43)
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The modeling of agricultural geosystems in different physical-geographical zones is discussed as a benchmark for the Priroda Earth remote sensing project. Geosystems are nonlinear dynamic complexes existing in both space and time. Investigations of geosystems consist of spatial structure analysis and determination of parameters of process. The model is represented as a phase trajectory of vegetation growth in the spectral signature space. The coordinates of phase trajectory are interpreted through biogeophysical parameters. The phase trajectory of vegetation growth is obtained from the row of sequence satellite and aircraft images. By experiment on the space data, spatial structures of geosystems (land use, river and erosion network) are proved to have fractal properties. The procedures of fractal dimension determination for different spatial structures are discussed. ESA

N93-23773# Marine Hydrophysical Inst., Sevastopol (USSR).
THE PROGRAM OF OCEANOLOGICAL EXPERIMENTS WITHIN THE PRIRODA PROJECT
G. K. Korotaev, V. K. Kosnyrev, V. N. Kudryavtsev, and V. S. Suetin *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1073-1077 (For primary document see N93-23748 08-43)
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The scientific program of oceanographic experiments within the Priroda Earth remote sensing project is presented. This program identified two specific goals: to determine accuracy estimations of main hydrophysical parameters; and to obtain new data on oceanic processes. The program is divided into four blocks according to the type of instumentation that is used: sea surface temperature, roughness, color, and ground truth supply. Different aspects of remote sensing problems are discussed. ESA

N93-23774# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin (Germany). Inst. fuer Weltraumsensorik.
GERMAN PARTICIPATION WITHIN THE INTERNATIONAL EARTH OBSERVATION MISSION PRIRODA
G. Zimmermann and E. Bach (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1079-1084 (For primary document see N93-23748 08-43)
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The Priroda project is a multisensor mission with active and passive microwave and optical sensors for Earth observation. These devices will be installed on board a specialized module which will be launched and docked at the Mir Station in May 1993. The goal of the mission is the development and verification of multisensor remote sensing methods for investigation of landscenes, oceans, atmosphere, and ecological environment. German participation in the Priroda mission includes contribution to the scientific payload, proposed scientific experiments, and cooperation in ground truth and data processing. As a payload contribution, the imaging spectrometer MOS (Modular Optoelectronical Scanner) was developed for optical sensing of oceans and atmosphere in the visible near infrared region. An overview of experiment proposals for the scientific program is given. ESA

N93-23775# Centre National d'Etudes Spatiales, Toulouse (France).
GLOBSAT/METOC: AN ALTERNATIVE APPROACH FOR A EUROPEAN EARTH OBSERVATION PROGRAMME FROM THE POLAR ORBIT
J. L. Fellous, J. P. Durpaire, D. Seguela, D. Breton, and A. Ratier (Centre National d'Etudes Spatiales, Paris, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1085-1091 Sponsored in part by MATRA (For primary document see N93-23748 08-43)
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In the framework of its Earth observation program, ESA selected a set of instruments to be carried on a large satellite using the Columbus platform. An alternative scenario of three dedicated missions, based on moderate size satellites using recurring elements from ERS/SPOT, is proposed. This solution, which meets the mission objectives, provides better flexibility and resiliency with respect to financial contingency, conflicting user requirements, difficulties during development, launch, and in-orbit operations. Having a perspective of continuity, the missions will be, in the future, under the responsibility of user entities. It is therefore proposed to develop a preoperational system which will be transferred at recurring costs, after in-orbit qualification. The results of a feasibility study, including both space and ground segments, for two components (Globsat for environment and Metoc for operational meteo/oceano) are presented. Concerning the ground segment, an integrated network of stations compatible with several dedicated satellites is described. ESA

N93-23776# European Space Agency, Paris (France).
OBSERVATIONS OF ATMOSPHERIC CHEMISTRY ON THE FIRST EUROPEAN POLAR PLATFORM
C. J. Readings and M. Rast *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1093-1097 (For primary document see N93-23748 08-43)
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An atmospheric chemistry mission will form part of the first European polar platform mission POEM-1. This mission will have two objectives, namely to contribute to the monitoring of key trace gas species such as ozone and to advance knowledge of species and processes. To achieve these objectives it is proposed to fly a set of specialized chemistry instruments. Together these instruments span a spectral range that extends from the ultraviolet to the mid-infrared viewing not only at the limb but also at nadir. The data from these instruments will be enhanced by those from other instruments also included in POEM-1. The candidate instruments comprising the POEM-1 chemistry mission are described: MIPAS (Michelson Atmospheric Sounding); GOMOS (Global Ozone Monitoring by Occultation of Stars); and SCIAMACHY (Scanning Imaging Absorption SpectroMeter for Atmospheric Cartography). ESA

N93-23777# Central Specialized Design Bureau, Samara (Russia).
EARTH RESOURCES AND ECOLOGICAL SPACECRAFT
A. E. Kazakova and V. D. Kozlov *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1099-1105 (For primary document see N93-23748 08-43)
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The Russian Resurs-F spacecraft, developed for Earth surface photography, with high resolution and accuracy in different spectral bands, for ecological and Earth resources study, are described. The Resurs-F spacecraft provides different scale multizonal and spectrozonal Earth surface surveys. Resurs-F2 provides synchronous multizonal and spectrozonal (or chromatic) photography of the Earth's surface, with pictures having high photometric and geometric characteristics. An operational description of

the spacecraft is given, and their products are discussed. The spacecraft's information is applicable in deposit exploration and other investigations of economic importance, in environmental control, and for scientific purposes. ESA

N93-23778# College for Civil Engineering, Bucharest (Romania). Lab. for Remote Sensing.

REMARKS AND PROPOSALS TO ADAPT SOME EARTH OBSERVATIONS SPACE PROGRAMMES IN THE PERIOD OF TRANSITION OF THE COUNTRIES OF CENTRAL/EASTERN EUROPE; FOCUSED ON ROMANIA

Nicolae Ch. Oprescu *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1107-1111 Prepared in cooperation with Romanian Space Agency, Bucharest (For primary document see N93-23748 08-43)

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Some of the transition period features in the Central/Eastern European countries and their implications are presented. Necessities in the remote sensing field, in the order of the priorities, are described. The present situation in Romania in this field, the organization, the endowment, the conception, some achievements, and results including some examples, are described. The basic features of space-based Earth observation programs, such as the 'Priroda' (nature) program, are shown, and suggestions for their adaptation to the needs of the developing countries, especially for Romania, are discussed. ESA

N93-23779# Lisbon Univ. (Portugal). Grupo de Oceanografia.

OBSERVING THE NORTHEAST ATLANTIC WITH NOAA-N AT THE UNIVERSITY OF LISBON (PORTUGAL) SPACE OCEANOGRAPHY FACILITY

Armando F. G. Fiuza and Paulo B. Oliveira *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1113-1116 (For primary document see N93-23748 08-43)

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A general description of recent activities in the domain of satellite oceanography is presented. A fully equipped space oceanography facility was installed in Dec. 1990, which includes a complete system for receiving, processing, and archiving HRPT data from the NOAA-N satellites. This facility constitutes the backbone of the SATOCEAN project whose objective is the development of the Portuguese capability in the area of satellite oceanography and of its application to marine resources exploration and management in a large region of the northeast Atlantic including the coastal seas and the extensive exclusive economic zone of Portugal. Under SATOCEAN, a comprehensive program of marine research and applications is being conducted with the support of NOAA/AVHRR (Advanced Very High Resolution Radiometer) data, including studies on the fine thermal structure of the upper ocean and on algorithms for the retrieval of Sea Surface Temperatures (SST) from satellite infrared measurements, research on the spatial structure and the temporal variability of SST in the northeast Atlantic, an investigation on coastal sediment dynamics, and a large subproject aiming at the operational support to fisheries. ESA

N93-23780# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany). Space Communications and Propulsion Div.

METEOSAT SECOND GENERATION ENHANCED VISIBLE-IR IMAGER SEVIRI AND ITS ENVIRONMENTAL MONITORING POTENTIAL

B. Kunkel, M. Deyerler, F. Pasternak (MATRA Espace, Toulouse, France.), R. Davacens (MATRA Espace, Toulouse, France.), C. A. Markland (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), and P. Olivier (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1117-1122 (For primary document see N93-23748 08-43)

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The enhanced mission scenario for Meteosat Second Generation (MSG), including the global change monitoring aspects, is described. The SEVIRI (Spinning Enhanced Visible and Infrared Imagers) is described. Emphasis is on the instrument design approach in response to these requirements. A planning survey is included. SEVIRI was designed with 11 to 13 spectral channels between 0.45 and 14.6 micrometer reduced sampling intervals, i.e. higher spatial resolution, and a factor 2 higher repetition rate plus higher raw image data quality requirements. Among the various spectral channels are imaging channels in the atmospheric windows from the visible to 12.5 micrometers as well as a set of 'pseudosounding channels', including an ozone channel. Thus, the mission scenario is much wider than the current Meteosat system. ESA

N93-23781# Academy of Sciences (USSR), Moscow. Flight Research Inst.

USAGE OF SMALL-SIZED AEROSPACE PLANE IN THE INFRASTRUCTURE OF SPACE RESEARCH OF THE EARTH

V. N. Bizov *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1123-1126 (For primary document see N93-23748 08-43)

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The possibilities and peculiarities of the usage of a Small Sized Aerospace Plane (SSASP) for global monitoring of the Earth's environment are discussed. The SSASP combines positive qualities of constant space based means and aviation means of Earth observation, so it can be used to research ecological, medical-biological, and technological problems in orbital part of the flight and in the regime of Earth reentry. Possibilities of broad SSASP maneuvering in the pitching and rolling plane with high lift drag to ratio provide a return of useful load and research objects from larger group of orbits as compared with ballistic capsule. The SSASP is a modification of an already known aerospace research plane 'Bor-4', which was tested in flight in 1982-84. ESA

N93-23782# Academy of Sciences (USSR), Moscow. Radio Engineering and Electronics Inst.

PRIRODA PROJECT: OPTICAL SENSORS FOR ENVIRONMENT RESEARCH

V. V. Efremenko and I. Pippi (Consiglio Nazionale delle Ricerche, Florence, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1127-1129 (For primary document see N93-23748 08-43)

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The Priroda common research program, developed for the analysis of the characteristics and the application of the spaceborne optical sensors operating in high spectral resolution mode for the remote sensing of the Earth, is reported. By means of the optical sensors to be placed on board of the Priroda module, the geophysical parameters useful for pollution monitoring and resources evaluation will be studied. Particular attention will be paid to the choice of the optimal wavelengths in the visible and infrared range in order to achieve the best results, taking into account the atmospheric contribution as well. ESA

N93-23783# European Space Agency, Paris (France).

THE FIRST MISSION OF THE ESA EARTH OBSERVATION POLAR PLATFORM

M. Rast and C. J. Readings *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1131-1134 (For primary document see N93-23748 08-43)

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The presentation of the planned contribution of ESA to Earth observation

and environmental monitoring during the polar platform era is given, outlining the main objectives and resulting in the main requirements for the first mission. The payload and the measurement goals of each instrument are described. Links between the payload and the objective of the first polar mission are summarized, and the ground segment structure is outlined.
ESA

N93-23784# Dornier System G.m.b.H., Friedrichshafen (Germany).
THE EUROPEAN POLAR PLATFORM AND ITS EARTH OBSERVATION MISSION
F. Tanner, D. Demuth, H. Munz, and P. Truss (British Aerospace Aircraft Group, Bristol, England.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1135-1140 (For primary document see N93-23748 08-43)
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The PPF/POEM-1 program is concerned with the development of the European Polar Platform (PPF) and its first utilization by the Polar Orbit Earth observation Mission-1 (POEM-1). The PPF is a multimission platform providing a modular system with flexible adaptability to a wide range of payload demands. POEM-1 is designed to monitor and study the Earth's environment including climate changes and to contribute to the operational meteorology. The instrument complement selected within the ongoing phase B comprises a well balanced set of ESA developed instruments, EUMETSAT meteorological instruments, and announcement of opportunity instruments. The mission objectives and characteristics are outlined and the various sensors and their uses are shown. The space segment is described, including the communication links. The schedule, established with a launch date of mid-1998, is outlined.
ESA

N93-23785# Aerospatiale, Cannes (France).
MEDIUM RESOLUTION IMAGING SPECTROMETER (MERIS)
G. Baudin, R. Bessudo, and J. L. Bezy (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1141-1146 Sponsored by ESA and Dornier System G.m.b.H. (For primary document see N93-23748 08-43)
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The Medium Resolution Imaging Spectrometer (MERIS) is a passive optical instrument that will fly on the first Polar Orbiting Earth observation Mission POEM-1, scheduled for launch in mid-1998. The instrument's primary goal is to monitor bio-optical ocean parameters on a large scale. The secondary goals of MERIS include atmospheric investigation on cloud and aerosols parameters and on land surface processes. The mission derived requirements and a general description of MERIS are given. The following are also described: imaging/optical concept; focal plane assembly and detection box; data processing; calibration; formatting and electrical architecture; mechanical/thermal aspects; intelligent interfacing to the payload command and control subsystem; and instrument performances.
ESA

N93-23786# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
MIPAS: MICHELSON INTERFEROMETER FOR PASSIVE ATMOSPHERIC SOUNDING FOR POEM-1
M. Endemann, R. Meynart, K. Hoerning (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany.), G. Lange (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany.), W. Posselt (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany.), and B. Fladt (Dornier System G.m.b.H., Friedrichshafen, Germany.) *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1147-1152 (For primary document see N93-23748 08-43)
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The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) is a high resolution Fourier Transform (FT) spectrometer for measuring concentration profiles of stratospheric constituents on a global scale. It is selected as an ESA payload for the first Polar Orbiting Earth observation Mission (POEM-1). MIPAS will observe the atmospheric emissions at the horizon of the Earth (limb) throughout the midinfrared region, which allows the simultaneous measurement of more than 20 key trace gases, including the complete NOx family and several CFC's. The design of MIPAS faced many challenges: it is the first spaceborne high resolution FT spectrometer designed for the observation of limb emissions. The need to achieve the required radiometric sensitivity and accuracy required for this type of measurement, the pointing knowledge and pointing stability during an interferogram recording, as well as the lifetime goal of four years of continuous operation are the design drivers of MIPAS.
ESA

N93-23787# Dornier System G.m.b.H., Friedrichshafen (Germany).
AN ADVANCED SCATTEROMETER FOR THE EUROPEAN POLAR PLATFORM
D. Miller, H. Ebner, P. Hans, H. Hoelzl, and H. R. Schulte *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1153-1157 (For primary document see N93-23748 08-43)
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The Advanced Wind Scatterometer (ASCAT) is a spaceborne instrument for ocean wind field measurement. The ASCAT was intended as a follow-on to the ERS-1 AMI (Active Microwave Instrument) scatterometer. Work is currently being carried out under a POEM-1 preparatory program ESA phase B contract. Future work may be directed to installation of ASCAT onto a meteorological platform. The advanced design and use of state-of-the-art technology results in less demand in platform resources. A three pair antenna configuration doubles the swath width. Novel internal calibration and antenna temperature sensing promise improved radiometric stability. An overview of ASCAT in terms of specification design, calibration, and performance, concentrating on the differences to the AMI scatterometer, is presented.
ESA

N93-23788# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Earth Observation Dept.
THE RADAR ALTIMETER INSTRUMENT FOR POEM-1 MISSION
A. Resti and G. Levrini (Alenia Spazio S.p.A., Rome, Italy.) *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1159-1164 (For primary document see N93-23748 08-43)
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RA-2 is a fully redounded nadir pointing pulse limited Radar Altimeter (RA) operating with a single antenna dish at 13.8 GHz and at 3.2 GHz. Its design is derived from the ERS-1 RA, but its new signal processing, which autonomously adapts the radar resolution to characteristic and topography of the Earth's surface, and its second fequency channel, will allow RA-2 to operate over ocean, ice, and land without interruption and to correct its height measurements for the errors introduced by the ionosphere. The RA-2 will fly in 1998 on the first European Polar Orbit Earth observation Mission (POEM-1). The RA-2 is to make use of the improved accuracy of its measurements to better understanding of the Earth's environment and to monitor it in global scale.
ESA

N93-23789# MATRA Marconi Space (England).
THE ADVANCED SYNTHETIC APERTURE RADAR (ASAR) FOR POEM-1
D. J. Q. Carter, S. S. Hartley, and G. Graf (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1165-1172 (For primary document see N93-23748 08-43)
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Europe's first Remote Sensing Satellite (ERS-1) was launched in Jul.

1991 with a preoperational Synthetic Aperture Radar (SAR) as a part of the payload. In order to achieve an operational system within a commercial environment, more flexibility and improved performance will be required. In 1998 ESA is due to launch the first Polar Orbiting Earth observation Mission (POEM-1). This provides the opportunity to fly the first of the next generation of SAR. This is the Advanced SAR (ASAR) which will enable the necessary European technology base for commercial SAR's to be proved. It will be the first to give global coverage and dual channel data. The ASAR objectives and requirements are given and the instrument is described, with advantages over the ERS-1 AMI (Active Microwave Instrument) pointed out. Calibration and characterization, modes of operation, and the predicted instrument performance are described. An outline of the SAR program is given. ESA

N93-23790# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

THE DESIGN OF THE ESA MULTIBAND IMAGING MICROWAVE RADIOMETER MIMR

Y. Menard and M. Reynolds *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1173-1177 (For primary document see N93-23748 08-43)

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The multifrequency Imaging Microwave Radiometer (MIMR) is an instrument to be flown on a polar platform due to be launched in 1998. The operational and functional parameters of MIMR and its mission objectives are described, and the performance, hardware concept, and design and calibration aspects are presented. The MIT is a leap forward in microwave radiometry with respect to already flown radiometers and will provide high performance microwave measurements for determination of global weather and critical oceanographic, atmospheric, cryospheric, and land parameters, to operational forecasts and users and the research community for the years beyond 2000. ESA

N93-23791# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany). Space Communications and Space Propulsion Dept.

BROADBAND IMAGING SPECTROMETER TECHNOLOGY AND ITS USE POTENTIAL FOR ENVIRONMENTAL CHANGE MISSION

B. Kunkel, F. Blechinger, and A. Schmitz-Peiffer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1179-1185 (For primary document see N93-23748 08-43)

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The Reflective Optics System Imaging Spectrometer (ROSIS) airborne, ROSIS-ATMOS (ROSIS within the ATMOS (Atmospheric and Environmental Satellite) program), ROSIS-02, and HRIS (High Resolution Imaging Spectromer) are imaging spectrometers for remote sensing of the ocean and atmosphere with high spectral and medium to high spatial resolution. While the airborne ROSIS was developed for regional monitoring, the other instruments are planned for global monitoring from space. An overview of the applications and technology concepts of these imaging spectrometers is presented. ESA

N93-23792# LABEN Ferranti International, Vimodrone (Italy).

DESIGN OF AN IMAGING SPECTROMETER PROCESSING CHAIN FOR SPACE APPLICATION

A. Bonati, P. Massa, E. Papa, L. Scandelli, and G. Simonetti *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1187-1191 (For primary document see N93-23748 08-43)

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The digital signal processing section of a breadboard spectrometer for use in space environments is described. The instrument is a candidate core instrument for the European Polar Platform and it is used for ocean and land monitoring. A key feature is the onboard correction of errors arising from the optical transducer. ESA

N93-23793# Officine Galileo S.p.A., Florence (Italy).

GLOBAL OZONE MONITORING EXPERIMENT

A. Mariani *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1193-1196 Sponsored by ESA Prepared in cooperation with LABEN Ferranti International, Vimofrone, Italy, and Technische Physische Dienst TNO-TH, Delft, Netherlands (For primary document see N93-23748 08-43)

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GOME (Global Ozone Monitoring Experiment) is designed to monitor from space absorption by trace gases in the Earth atmosphere. The instrument will take spectra of the backscattered solar radiation in the spectral range 240 to 790 nm, with a spatial resolution, on ground, of 40 km and a spectral resolution of 0.2 nm. It will use a four channel spectrometer, based on holographic gratings, and cooled arrays of 1024 pixels each as detectors. The integration time can be set within 0.1 and 1500 sec. The instrument will provide the scientific community with the possibility to monitor the column amount and the profile of ozone and the column amount of a variety of trace gases and aerosols by exploiting both DOAS (Differential Optical Absorption Spectroscopy) and SBUV (Solar Backscattered UV light) retrieval techniques. ESA

N93-23794# Italian Space Agency, Rome.

IASI (INFRARED ATMOSPHERIC SOUNDING INTERFEROMETER): PROGRAMME OBJECTIVES AND STATUS

B. Bizzarri, F. Pasquali, G. Sylos-Labini, F. Cayla (Centre National d'Etudes Spatiales, Toulouse, France.), G. Chalon (Centre National d'Etudes Spatiales, Toulouse, France.), A. Chedin (Centre National d'Etudes Spatiales, Toulouse, France.), and A. Ratier (Centre National d'Etudes Spatiales, Toulouse, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1197-1202 (For primary document see N93-23748 08-43)

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The ISAI (Infrared Atmospheric Sounding Interferometer) project for advancing the performances of the sounding mission for operational meteorology and observing column integrated contents of a few greenhouse gases is reported. It is based on a Michelson interferometer. It embeds a high resolution imaging channel for co-registration with the AVHRR (Advanced Very High Resolution Radiometer) imager. Interferograms will be processed on board to provide the user with 9200 channels of unapodized spectral data. POEM-1 (Polar Orbit Earth observation Mission) is envisaged to be the first flight opportunity for IASI. ESA

N93-23795# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany).

MILLIMETER WAVE ATMOSPHERIC SOUNDER (MAS)

G. K. Hartmann, N. Kaempfer (Bern Univ., Switzerland.), P. R. Schwartz (Naval Research Lab., Washington, DC.), and K. F. Kuenzi (Bremen Univ., Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1203-1206 (For primary document see N93-23748 08-43)

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MAS is a remote sensing instrument for passive sounding (limb sounding) of the Earth's atmosphere from the NASA Space Shuttle. Millimeter wave radiation emitted by the stratosphere and mesosphere in the range between 10 and 100 km will be measured at 61, 62, 63, 183, 184, and 204 GHz with a resolution of better than 4 km. MAS data yield direct information about the height distribution of temperature, pressure, water vapor, ozone, and chlorine monoxide, in the atmosphere and mesosphere, in the latitude ranges +/- 74 deg. MAS will be flown as part of the ATLAS (Atmospheric Laboratory for Applications and Science) missions 1 to 3 (1992-1994); ATLAS 1 is scheduled for 23 Mar. 1992. Further flights on ATLAS missions 4 to 10 are presently under discussion. ATLAS 1 and 2 will occur during

the flight of the Upper Atmosphere Research Satellite (UARS) and MAS will supply important correlative data. ESA

N93-23796# Technische Univ., Munich (Germany). Remote Sensing Working Group.

MOMS-02P: A MODULAR OPTICAL SYSTEM FOR EARTH LAND COVER OBSERVATION IN THE MULTISENSOR ENVIRONMENT OF THE PRIRODA/MIR MISSION

Johann Bodechtel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1207-1208 (For primary document see N93-23748 08-43)

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The Modular Optoelectronic Multispectral Stereoscanner (MOMS) is taken into consideration for a preoperational long term mission on the Russian research module Priroda after its operation in the experimental D2 German Spacelab mission D2 in Jan. 1993. Scientific objectives of the mission are described and tests sites for pilot studies are given. ESA

N93-23797# ¸Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Hochfrequenztechnik.

X-EOS: A MULTI-MODE X-BAND SYNTHETIC APERTURE RADAR FOR EOS SAR

Herwig Oettl and Manfred Wahl (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1209-1214 (For primary document see N93-23748 08-43)

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The role of polarimetric multifrequency SAR (Synthetic Aperture Radar) systems in investigating global phenomena such as the carbon cycle, hydrological cycle, climate and geological processes, as well as ocean circulation and air-sea interactions, is discussed. Based on user requirements for image performance and rapid change of operational modes, a concept is proposed which involves active phased array antennas for L, C and X band. This SAR system will offer immediate switching of parameters, for example incidence angle, selection of swath with and geometric resolution. The antennas will use transmit/receive modules employing GaAs technology. The latter are designed as Monolithic Microwave Integrated Circuits (MMIC's). The interdependence of system parameters, the major operational modes, and some technological aspects are described for the X band SAR. ESA

N93-23798# Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn (Germany).

X-SAR: THE GERMAN/ITALIAN CONTRIBUTION TO REALIZING A MULTIFREQUENCY SYNTHETIC APERTURE RADAR FOR REMOTE SENSING FROM SPACE

M. Wahl, P. Ammendola (Italian Space Agency, Rome.), H. Oettl (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany.), and P. Pampaloni (Consiglio Nazionale delle Ricerche, Florence, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1215-1219 (For primary document see N93-23748 08-43)

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X-SAR is a Shuttle Borne imaging Synthetic Aperture Radar (SAR) operating in X band (9.6 GHz). It is being developed and operated in a joint venture between Germany and Italy. Integrated together with the L band (1.25 GHz) and C band (5.3 GHz) radar SIR-C of NASA, X-SAR will become part of a multifrequency/multipolarization SAR facility, called Shuttle Radar Lab (SRL). SRL will be operated for approximately 50 hrs during each of the envisaged flights. The first 9 days mission is scheduled for 30 Sep. 1993, the second for Dec. 1994 and the third for Spring 1996; the flight sequence allows monitoring of seasonal changes. ESA

N93-23799# Bulgarian Academy of Sciences, Sofia. Solar-Terrestrial Influences Lab.

METHOD FOR ENHANCING OF THE SPATIAL RESOLUTION OF THE PASSIVE RADIOMETRIC SYSTEMS

D. N. Mishev *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1221-1225 (For primary document see N93-23748 08-43)

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A method for an indirect enhancement of the spatial resolution of the passive radiometric systems is proposed. A joint processing of radiometric and multichannel videosystems data is used. The application of the method is planned in the framework of the 'Priroda' multipurpose space remote sensing project. ESA

N93-23800# Kayser Threde G.m.b.H., Munich (Germany).

HIGH RESOLUTION STEREO IMAGES FROM THE SPACE STATION MIR

V. Liebig *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1227-1229 (For primary document see N93-23748 08-43)

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The orbital parameters of the Mir space complex are presented and the KFA-1000 camera system is described. The ground resolution of the images is about 7.5 m, the ground coverage 120 by 120 sq km. To keep track of the thousands of photos, a database system was installed. Plots of the available images are produced after every acquisition period. On customer request special acquisition campaigns are organized for selected areas. The operational flow of a special acquisition mission is introduced. The camera system offers high resolution stereo images for many purposes at low costs. ESA

N93-23801# Technische Univ., Munich (Germany). Remote Sensing Working Group.

NEW IMAGES OF THE EARTH IN HIGHEST RESOLUTION: MOMS-02 ON THE SECOND GERMAN SPACELAB MISSION D2

J. Bodechtel and S. L. Jutz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1231-1235 (For primary document see N93-23748 08-43)

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MOMS-02 (Modular Optoelectronic Scanner) is an optical multispectral three line scanner, which will be flown early 1992 on board the American Space Shuttle during the Second German Spacelab mission D2. MOMS-02 acquired data in the visible and near infrared range and provides along track stereo acquisition capability through off nadir and nadir looking optics. The data will be used for a broad range of geoscientific objectives and enable the combination of thematic and topographic information within one single system. ESA

N93-23802# Technische Univ., Munich (Germany). Inst. for Land Use Planning and Nature Conservation.

SIMULATION OF MOMS-02 STEREO BAND RADIOMETRIC CAPABILITY USING FIELD SPECTROSCOPY DATA

T. Schneider, U. Ammer, B. Koch, and A. Scherer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1237-1240 (For primary document see N93-23748 08-43)

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MOMS-021 (Modular Optoelectronic Multispectral Scanner) is an Earth sensing charge coupled device instrument designed as a pushbroom scanning device for spectral data acquisition in the visible and near infrared range, combined with an along track stereo capability provided with one

nadir and two tilted modules 21.43 deg fore and after off nadir. In order to quantify the differences in signal response due to the look directions of the MOMS-02 stereo bands, they were simulated by spectroradiometer measurements. Compared to the average value of the nadir looking measurements of all expositions, depending on Sun inclination, slope and aspect, reflectance differences from 63 to 148 percent for the same uniform grass canopy, were found. ESA

N93-23803# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

THE INTERNATIONAL SPACE YEAR PROGRAMME

B. R. K. Pfeiffer *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1243-1247 (For primary document see N93-23748 08-43)

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The International Space Year (ISY) 1992 is a worldwide initiative to enhance international collaboration in the field of space research and to increase public awareness of the benefits of space research for a better understanding of the burning problems of the Earth's environment. Key space missions which contribute to the ISY are: the Upper Atmosphere Research Satellite (UARS) of NASA; the European Remote Sensing Satellite (ERS-1) of ESA; the Japanese Earth Resources Satellite (JERS-1) of NASDA. Organization by SAFISY (Space Agency Forum on ISY) is described. The Earth science and technology projects, education and applications projects, and the space sciences projects are outlined. Special events are listed. ESA

N93-23804# Paris VI Univ., Verrieres-le-Buisson (France).

COSPAR/SAFISY PANEL OF EXPERTS ON SPACE SCIENCE SCIENTIFIC PROGRAM FOR THE ISY

A. Chantal Levasseur-Regourd, L. E. Peterson (California Univ., San Diego.), and A. C. Nishida (Tokyo Univ., Sagamihara, Japan.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1249-1251 (For primary document see N93-23748 08-43)

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The purpose of the panel of experts on space sciences was to assist the Space Agency Forum for the International Space Year (SAFISY) in planning for the ISY. The group developed specific suggestions for scientific activities in all scientific disciplines of COSPAR (Committee on Space Research), except Earth sciences which are under the auspices of the SAFISY Panel of experts on Earth sciences and technology. 'Perspectives from space' is recommended as the main theme for the space science activity. The origin and aims of the panel are presented. Twenty seven projects proposals were identified by the panel as activities intended to expand and facilitate current space science efforts and understanding, and endorsed by SAFISY. These projects, twenty one directly related to science and six related to education and outreach projects, are summarized. ESA

N93-23805# National Oceanic and Atmospheric Administration, Washington, DC. National Environmental Satellite Data and Information Service.

NOAA PARTICIPATION IN ISY EARTH SCIENCE AND OTHER ACTIVITIES

Russell Koffler, Jack Koeppen, D. Brent Smith, and Lawrence M. G. Enomoto *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1253-1254 (For primary document see N93-23748 08-43)

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The U.S. National Oceanic and Atmospheric Administration (NOAA) is contributing to and participating in many of the projects and associated global change outreach efforts of the SAFISY (Space Agency Forum for the International Space Year) Panel of Experts on Earth Science and Technology, as well as in other ISY applications, training, and space education activities. NOAA participation in a number of SAFISY Earth science and technology activities and other ISY related activities are described. These include: Greenhouse Effect Detection Experiment (GEDEX); Polar Stratospheric Ozone (PSO); World Forest Watch; Global Sea Surface Temperature (GSST); Polar Ice Extent (PIE); and global change encyclopedia, atlas, and video. ESA

N93-23806# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany).

GERMAN CONTRIBUTIONS TO THE INTERNATIONAL SPACE YEAR ISY 1992

H. D. Schlichter, W. Steinborn (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany.), and A. Bludau (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1255-1258 (For primary document see N93-23748 08-43)

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Activities initiated in Germany within the framework of the ISY (International Space Year) theme 'Mission to Planet Earth' are reported. A number of ISY projects which serve as an example for application of data from Earth observing satellites in land use research and educational activities are presented. Some management experiences made during the attempt of engaging the scientific community to ISY are discussed. ESA

N93-23807# Swedish Space Corp., Solna.

THE SWEDISH ISY PROJECTS: A JOINT NATIONAL CONTRIBUTION

H. Oesterlund and A. Rosenqvist *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1259-1261 (For primary document see N93-23748 08-43)

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The Swedish contribution in the celebration of the International Space Year (ISY) materialized in an active participation in the World Forest Watch project of the Earth Science and Technology panel and in the Training in Remote Sensing Applications program within the panel Education and Applications. The Swedish World Forest Watch contributions formed under the theme of 'Remote Sensing for Forest Management'. The projects comprise a wide range of forest and forestry remote sensing applications using different technical approaches. ESA

N93-23808# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.

OCEAN COLOUR PROGRAMMES FOR THE EUROPEAN MARINE ENVIRONMENT

V. Barale, P. Schlittenhardt, and L. Fusco (European Space Agency. ESRIN, Frascati, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1263-1267 (For primary document see N93-23748 08-43)

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The Ocean Color European Archive Network (OCEAN) project and Ocean Color Techniques for Observation, Processing, and Utilization Systems (OCTOPUS) program are described. OCEAN was aimed at the generation of a data base of bio-optical information in the marine environment, derived from the historical data originated by the CZCS (Coastal Zone Color Scanner) experiment, promotion of the use of ocean color data, and the development of a user network. The present phase of the OCTOPUS program is centered on the utilization of the scientific tools developed within the OCEAN program and on the availability of SeaWiFS (Sea viewing Wide Field of view Sensor) mission data. The program integrates three main components, devoted respectively to: data acquisition, archival and distribution, data processing, scientific analysis and coordination of research efforts, and research activities to be conducted in various European institutions. ESA

N93-23809# European Space Agency. European Space Operations Center, Darmstadt (Germany). Mission Analysis Section.

THE SPACE DEBRIS ENVIRONMENT FOR REMOTE SENSING SATELLITES **c18**

H. Klinkrad *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1269-1275 (For primary document see N93-23748 08-43)

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The data sources for the deterministic (greater than 10 cm), the nondeterministic (greater than 1 cm) and the small size space debris population (less than 1 cm) are reviewed, including assessments of their expected accuracy. Based on the USSpaceCom (United States Space Command) catalog, spatial object distributions and their effect in low Earth orbit collision risks are analyzed with due regard to remote sensing platforms (ERS-1, Polar Platform, Columbus). Conclusions on the growth of man made space debris, avoidance of catastrophic collisions, and spacecraft operability improvement, are given. Current knowledge of the space debris environment is mainly based on data in particulates smaller than 1 mm (retrieved surfaces) and larger than 10 cm (USSpaceCom Catalog). Inflight sensors on Sun synchronous orbits are suggested as best suitable to improve knowledge in the poorly observable yet high collision risk 1 mm to 10 cm debris objects, so far only analyzed by experimental ground based 'spot checks'. Such instruments could fly either in dedicated platforms or as passengers of remote sensing missions. ESA

N93-23810# EFTAS Fernerkundung Technologietransfer, Muenster (Germany).

THE MARINFOSEC STUDY: USE OF ERS-1 FOR CRUISE AND SAILING BOATS **c32**

K.-U. Komp *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1277-1278 (For primary document see N93-23748 08-43)

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A study within the ERS-1 framework, Marinfosec (improvement of nautical information for yachting, touristic cruising and tourisitic marine security), is presented. Actual and reliable information on wave direction and height could increase marine security in many fields, especially for cruise and sailing boats. ERS-1 data from SAR (Synthetic Aperture Radar) and AMI (Active Microwave Instrument) recordings will provide all weather data on wave direction and length, wave height and wind vectors. A broad range of applications of those data would be welcomed if presented right in time in a simple form. The objective is to provide actual wave maps distributed by weather fax. The demand structure and marketing potentials are studied, potentials of acceptance are evaluated, a model for later real time data processing and distribution is designed, future satellite configuration and the terms for a practical test phase are defined. ESA

N93-23811# Institut de la Carte Internationale de la Vegetation (France).

MONITORING OF DEFORESTATION: RESULTS OF THE BANGKOK CONFERENCE

F. Blasco, E. Janodet, and J. C. Cazaux (SCOT Conseil, Toulouse, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1279-1282 (For primary document see N93-23748 08-43)

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Results obtained in the SEAMEO France project in 1989-1991 are reported. This is a three year project that was started in 1989 by SEAMEO with technical and financial support from France, with the Philippines, Indonesia, Malaysia and Brunei Darussalem participating in the project. The ultimate end product will be the development of methodologies and training in monitoring deforestation using satellite data for sustainable environmental management. The project offers an opportunity to transfer to the SEAMEO countries the knowhow required to carry out surveys in the state of deforestation. NOAA satellite data is used for small scale information over large areas and SPOT satellite data are used for detailed operational information over selected test sites. The overall project concept includes training of scientist (about 20 national scientists in two years) in image processing, image analysis, and ultimate production of maps and statistics on deforestation. ESA

N93-23812# Technische Univ., Berlin (Germany). Inst. of Landscape Planning and Nature Conservation.

TRAINING COURSES ON APPLICATION OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS IN MONITORING AND MANAGING TROPICAL RAINFORESTS AND NATURAL ENVIRONMENT

Martin Runkel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1283-1286 (For primary document see N93-23748 08-43)

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An overview on international training courses on remote sensing and Geographic Information Systems (GIS) is presented. The main aim is to provide background knowledge as well as practical experience in the application of airborne and spaceborne remote sensing and the handling of GIS techniques in monitoring and managing tropical rainforests and natural resources. The region of special interest is south east Asia. Participants of the courses are foresters, geographers, landscape planners and persons with related professions, who already have some experience in the mentioned topics. ESA

N93-23813# Deutsche Gesellschaft fuer Technische Zusammenarbeit, Eschborn (Germany).

MONITORING DESERTIFICATION IN PATAGONIA/ARGENTINA, USING SATELLITE DATA FOR SUSTAINABLE ENVIRONMENTAL MANAGEMENT

Volker Roenick and J. Ayesa (Instituto Nacional de Tecnologia Agropecuaria, Bariloche, Argentina.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1287-1290 (For primary document see N93-23748 08-43)

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General features in Patagonia are presented and the setting up of a project of control of desertification is described. The most serious ecological problem of Patagonia is its more or less gradual desertification: advancing degradation and loss of natural resources, especially vegetation and soils, mainly caused by overgrazing in dominant sheep farming. The project of technical cooperation is presented. This project is dealing with systematical inventories of desertification processes, implementation of measures of control, and ecological monitoring system. ESA

N93-23814# Office Regional de Mise en Valeur Agricole de Ouarzazate (Morocco).

CONTRIBUTION OF REMOTE SENSING AND GIS FOR RANGELAND MANAGEMENT IN THE REGION OF OUARZAZATE (MOROCCO)

Abou Bekr Seddik Gueddari and Christian Crepeau (SCOT Conseil, Toulouse, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1291-1292 (For primary document see N93-23748 08-43)

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The rangelands in the Ouarzazate area are severely degraded because of the overgrazing, the cutting of woody species for fuel use, and the ploughing of the best ranges. A project for the improvement of these arid and semi-arid rangelands is reported. The project has three components: botanical and phytomass monitoring with ground stations; ecological and pastoral monitoring with remote sensing; and zootechnical and sanitary monitoring. ESA

N93-23815# Paris VI Univ. (France). Lab. de Geologie-Geomorphologie Structurale et Teledetection.

CARTOGRAPHY OF HAZARDS FROM GEOLOGICAL INSTABILITIES: VOLCANIC REGIONS IN PERU

J. Chorowicz, F. Garcia (Instituto Geofisico del Peru, Arequipa.), D. Huaman-Rodrigo (Instituto Geofisico del Peru, Arequipa.), B. Deffontaines, Richard Guillande (Geoscience Consultants, Paris, France.), J.-F. Parrot, and C. Ichoku *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1293-1295 (For primary document see N93-23748 08-43)

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Research and training activities concerning a test zone in the vicinity of the town of Arequipa, were focused on the utilization of space imagery and other digital data for the cartography of hazards in volcanic areas. High ground resolution SPOT XS and P imagery permitted the follow up of the eruption of Sabancaya volcano, from the pre-eruptive stage in 1986 to continuous eruption starting in May 1990. Successive stereoscopic SPOT scenes were used to describe and monitor the various geological hazards linked with the eruption. A geodynamic model gave indications on the gross distribution of major hazards in the region. Digitized topogaphic data appeared to be very efficient for portraying large landslides. Digital Elevation Model (DEM) processing showed for the first time in this region a very large collapse affecting a whole volcanic caldera. The superimposition in a Geographic Information System (GIS) of all available geoenvironmental and geographic data concerning the Arequipa area and the Misti volcano provides information on the major geological risks threatening the town of Arequipa. ESA

N93-23816# Groupement pour le Developpement de la Teledetection Aerospatiale, Toulouse (France).

GEOENVIRONMENT CARPATHES PROJECT [PROJECT GEOENVIRONNEMENT CARPATES]

Andre Fontanel and Jean Chorowicz (Paris VI Univ., France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1297-1299 In FRENCH (For primary document see N93-23748 08-43)

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The GeoEnvironment Carpathes project to develop European cooperation in the domain of geosciences and environment is described. The project will contribute to better understanding of geological phenomena controlling the Carpathian chain thus allowing prospective oil and gas structures to be forescast and located. An objective of the project is also to define a common methodology to use geocoded remote sensing data to monitor on soils and vegetation, environmental impacts of oil, gas and mining or more generally natural resources exploitations. The participants are various organisms and institutes from western and eastern Europe. They have already started to exchange their scientific experience and geological knowledge of the Carpathian chain and will build together, in selected areas and by using common standards, a digital data base including topographic data, geocoded remote sensing images, geological contours, selected geophysical data, and locations of mining and oil exploitations. Initial and professional training of personnel is an important part of this program. ESA

N93-23817# International Inst. for Aerospace Survey and Earth Sciences, Enschede (Netherlands).

APPLICABILITY OF SATELLITE REMOTE SENSING FOR SLOPE INSTABILITY HAZARD ZONATION

Niek Rengers and Robert Soeters *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1301-1305 (For primary document see N93-23748 08-43)

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The possibilities and limitations of scale and resolution of remote sensing imagery, when it is used for slope instability hazard analysis, are discussed. Key factors are the size of the slope instability phenomena and the various scales at which hazard maps should be prepared for regional, local, and site planning purposes. Conclusions are presented about the applicability of available types of airborne and satellite remote sensing imagery and desirable developments for the future are indicated. ESA

N93-23818# Centre National de Teledetection, Tunis (Tunisia).

RESULTS OF INTERNATIONAL MEETING HELD IN TUNIS (TUNISIA)

Mohamed Gammar *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1307-1308 (For primary document see N93-23748 08-43)

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The results of an international meeting on 'urbanization and remote sensing, geographic information system, and environment' are reported. The results lead to: the contribution of remote sensing; the need to initiate remote sensing projects in conjunction with clearly defined needs; the importance of validating the obtained results with the thematic partners; the need to concentrate efforts on the integration of these results, by the partners, into their own information system. The meeting allowed participants to prove that a better understanding of problems (urbanization, agriculture, natural resources) requires a south-south and north-south extended collaboration for a better control of methodologies and standards. ESA

N93-23819# Centre National de Teledetection, Tunis (Tunisia).

STUDY OF THE CULTIVATED LAND LOSSES AROUND TUNIS

Wafa Essahli and P. N. Pascaud (SCOT Conseil, Toulouse, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1309-1310 (For primary document see N93-23748 08-43)

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The monitoriong of the growth of the city of Tunis (Tunisia) is addressed. A project to provide planners with the necessary tools for monitoring is reported. This project has three main goals: to map the land use changes in the Tunis district; to implement a database; and to contribute to the revision of the urban development plan. The project is intended to be carried out over a period of two years. Several institutions are working for the project: the District of Tunis, the agency for urban development and land management, the agency for agricultural production, and the national agency for environmental protection. The transfer of this methodology to other cities and countries has already started. ESA

N93-23820# European Space Agency, Paris (France).

THE WORLD WIDE LAUNCHING CAMPAIGN FOR STUDENT ROCKETS EXPERIMENTAL PAYLOADS

Hans H. vonMuldau *In its* Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1311-1316 (For primary document see N93-23748 08-43)

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A meeting of youth and student teams coming from many different countries around the planet Earth to launch experiments and rocket vehicles of their own design and construction is described. Safety was a major consideration during the campaign, and a request was made for the propulsive units to be produced from a professional environment. Organization is another major topic of the campaign and the students have a great opportunity to share mutual experience. ESA

N93-23821# Euroavia, Garbsen (Germany).

EUROAVIA DESIGN WORKSHOP 1991: ORGANIZATION AND LESSONS LEARNED **c18**

Cristian Bank and Norbert Pailer (Dornier System G.m.b.H., Friedrichshafen, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations,

Legal Aspects 1992 p 1317-1322 (For primary document see N93-23748 08-43)
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The lessons learned during, and results of, the EUROAVIA (European Association of Students of Aeronautics and Astronautics) Design Contest and Workshop 1991 are presented. During the two weeks of the workshop, 22 students and 12 engineers and scientists from 11 nations designed a scientific satellite for enhancing the value of the Ulysses mission. Special emphasis is put on discusssing the organizational background and lessons learned during the preparation and the course of the workshop, also taking into account the participants' and industries' point of view. Those who want to organize similar events in the future will find some hints on how to optimize their efforts and to avoid some obstacles. ESA

N93-23822# Geospace G.m.b.H., Bonn (Germany).
REMOTE SENSING OF THE EARTH: A PILOT PROGRAM IN GERMAN SCHOOLS
Reinhard Maetzel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1323-1324 (For primary document see N93-23748 08-43)
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Difficulties encountered in using remote sensing imagery, in the past, as a mean of instruction in schools are discussed and a pilot program to introduce interactive methods in the teaching of remote sensing is described. The program primarily uses software and image data sets. The equipping of the schools, the instruction of the teachers, and the necessity for the schools to determine a regional project as course focus are outlined. ESA

N93-23823# Chen (W. T.) Co., Acton, MA.
INNOVATIVE INTERACTIVE EARTH SYSTEMS SCIENCE COURSEWARE FOR MIDDLE AND HIGH SCHOOL STUDENTS c42
W. T. Chen and G. Miller (WGBH Educational Foundation, Boston, MA.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1325-1327 (For primary document see N93-23748 08-43)
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An innovative two part Earth systems science course is being developed for middle and high school students throughout the U.S. The course will be formatted on interactive video discs and be interfaced with a television monitor and either a Macintosh or IBM PC compatible computer. This innovative courseware will enable teachers and students, for the first time, to combine historical and the most current test graphics, statistical data, audio, and video footage on Earth systems science to produce creative and dynamic lesson plans, class reports, and presentations. Earth science phenomena will be presented in the context of global change and according to the timescale framework described in the Earth systems science literature. When completed, the courseware, entitled 'Interactive NOVA Earth', may be used by over 100,000 American classrooms each year. If appropriate, the courseware may also be made available in other languages. ESA

N93-23824# Ministere de l'Education Nationale, Paris (France). Direction des Lycees et Colleges.
SPACE TECHNOLOGIES IN FRENCH EDUCATION [LES TECHNOLOGIES SPATIALES DANS L'EDUCATION EN FRANCE] c80
A. Elie *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1329-1330 In FRENCH (For primary document see N93-23748 08-43)
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The extension of applications and research from space technology in education in France is reported. The pedagogic use of satellite Earth observations, in particular SPOT imagery, is discussed. The consequences and advantages of experience of image analysis in class on education are discussed. Cooperation between the French National Ministry of Education and the French National Center for Space Studies (CNES) is described. ESA

N93-23825# Southampton Univ. (England). Dept. of Oceanography.
COMPUTER-BASED LESSONS IN SATELLITE OCEANOGRAPHY: AN ACADEMIC NETWORK FOR TEACHERS AND STUDENTS c48
Ian S. Robinson, David Blackburn (Bureau International des Poids et Mesures, Sevres, France.), Richard Callison (Pharos Scientific Ltd., Dundee, Scotland.), and Dirk G. Troost (United Nations Educational, Scientific and Cultural Organization, Paris, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1331-1336 (For primary document see N93-23748 08-43)
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A computer based learning system for satellite oceanography developed and distributed by UNESCO (United Nations Education, Science, and Culture Organization) is reported. At its core is a simple PC based image processing software package named Bilko, designed for use on widely available MS-DOS personal computers. Since 1989 three modules of images have been published, each containing the software and a number of image datasets on magnetic disks and a booklet of printed lessons. The images are datasets of ocean variables. Educators using the material have responded by contributing lessons of their own, resulting in the growth of an educational network which feeds the production of further educational material containing examples of satellite data from all oceans of the world. Further modules are in preparation, and eventually all the lesson material will be placed on a Compact Disc Read Only Memory (CD-ROM). ESA

N93-23826# United Nations, New York, NY. Outer Space Affairs Div.
CENTRES FOR SPACE SCIENCE AND TECHNOLOGY EDUCATION: A UNITED NATIONS INITIATIVE c80
Adigun Ade Abiodun *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1337-1341 (For primary document see N93-23748 08-43)
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The United Nations initiative to establish regional centers for space science and technology education provide a unique opportunity in developing countries for the development of skills and knowledge in remote sensing technology at local level. Knowledge and skill development is described and recommendations for space science and technology education are discussed. ESA

N93-23827# Ruhr Univ., Bochum (Germany). Astronomical Inst.
THE ROLE OF PLANETARIUMS IN PROMOTING SPACE SCIENCES c14
Johannes Viktor Feitzinger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1343-1346 (For primary document see N93-23748 08-43)
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The planatarium is effective in both cognitive and affective domains. Belonging to the oldest teaching mass media it is a tool to diversify the sensory stimulus; the more diversified the sensory stimulus, the more differentiated the learning and entertainment process of the public visiting a planetarium performance. In Germany nearly 2 million visitors per year are counted in planetariums. Space sciences are ideal for a presentation in planetariums and for general education purposes. The content and the didactic of planetarium performances are discussed. ESA

N93-23828# Nairobi Univ. (Kenya). Dept. of Electrical and Electronic Engineering.
THE TROPICAL SCHOOL FOR ATMOSPHERIC AND SPACE SCIENCES: AN INTERNATIONAL PROJECT PROPOSAL c80

Robert JallangoAkello *In* ESA, Environment Observation and Climate Modelling Througn International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1347-1351 (For primary document see N93-23748 08-43)
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A general discussion on the expansion of engineering applications since the discovery of electromagnetic waves is given, and a proposal for a Tropical School for Atmospheric and Space Sciences, where objective research in interlinked discipline areas could be carried out is presented. Advantages for a proposed site at Maseno, Kenya are discussed. Target programs in areas using electromagnetic waves for investigations are outlined: telecommunication and electronics, astronomy, geodetic studies, advanced meteorology, environmental sciences, and biotechnology. Possible donors to date are listed: individual countries and institutions, United Nations agencies, and international consortia. ESA

N93-23829# Ministere de l'Education Nationale, Paris (France). Direction des Lycees et Colleges.
REMOTE SENSING SATELLITE AND THEMATIC APPLICATIONS IN HIGH SCHOOLS AND ELEMENTARY SCHOOLS IN FRANCE [SATELLITE DE TELEDETECTION ET APPLICATIONS THEMATIQUES DANS LES LYCEES ET COLLEGES EN FRANCE] **c80**
M. Vauzelle *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1353-1355 In FRENCH Preprared in cooperation with CNES, Paris, France (For primary document see N93-23748 08-43)
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The Secondary Schools Directorate of the French Ministry of Education managed a national experimentation to introduce the pedagogical use of the satellite remote sensing images in class. A software is used and a data bank of digital images was set up. Twenty eight high schools are involved in this interdisciplinary (physics, biology, and geography) experimentation. To spread the results of the action, summer training courses are held. An international training course is to open in 1992 to French and foreign teachers. ESA

N93-23830# Gymnasium Neuenbuerg (Germany).
SATELLITE-IMAGES IN SECONDARY EDUCATION IN BADEN-WUERTTEMBERG (GERMANY) **c80**
Bruno Pohl *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1357-1361 (For primary document see N93-23748 08-43)
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Digital and analog satellite images are used as teaching tools in secondary education. In particular, geography and ecology courses make use of these data. Students learn about orientation on satellite images, how they are obtained, and how they can be interpreted. The data provided range from weather maps (METEOFAX) to LANDSAT images on paper to digital image processing. ESA

N93-23831# Wuhlheide Leisure und Recreation Centre, Berlin (Germany).
SPACE RESEARCH AS A TOOL TO ACQUAINT CHILDREN AND YOUNG PEOPLE WITH SCIENCE AND TECHNOLOGY **c80**
Werner Bachmann and Judika Jentsch *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1363-1367 (For primary document see N93-23748 08-43)
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An introduction to the Space Flight Center at the Wuhlheide leisure and recreation center in Berlin (Germany) is presented. It will look into the question of how space flight and space exploration is used to introduce children and young people to scientific and technical matters and engender their interest. The aims, contents, and methods involved in showing young people of different ages the purpose and benefits of space exploration are described. A survey of events and hobby groups organized to aquaint children and young people with such aspects of space exploration is provided. ESA

N93-23832# Zurich Univ. (Switzerland). Remote Sensing Labs.
ASSESSMENT AND CORRECTION OF THE IMPACT OF TOPOGRAPHY AND ATMOSPHERE ON REMOTE SENSING FOREST MAPPING OF ALPINE REGIONS
K. I. Itten, P. Meyer, T. Kellenberg, S. Sandmeier, R. Leu, P. Bitter, and K. Seidel (Eidgenoessische Technische Hochschule, Zurich, Switzerland.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1369-1371 (For primary document see N93-23748 08-43)
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Methodologies to improve LANDSAT TM (Thematic Mapper) forest classifications of alpine regions through the removal of some radiometric and geometric distortions are tested. Besides correcting for sensor and system induced errors, geometric corrections are performed using a digital elevation model. Scene related effects such as differences in illumination as well as the height dependent atmospheric influence and adjacency effects are corrected. The obtained improvement of the forest classification accuracy can be demonstrated against excellent ground truth. ESA

N93-23833# Canada Centre for Remote Sensing, Ottawa (Ontario).
GEOSCOPE: AN INTERACTIVE GLOBAL CHANGE ENCYCLOPEDIA **c45**
Rejean Simard *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1373-1377 (For primary document see N93-23748 08-43)
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An interactive global change encyclopedia (GEOSCOPE), portraying the contribution that remote sensing from space can make to the monitoring of global environmental change on Earth, is being produced for the International Space Year (ISY) in 1992. The data in the encyclopedia will provide global coverage for more than forty parameters from various remote sensing satellites and from ancillary map documents. Other related data, usually with greater spatial resolution, will cover continental and regional areas to illustrate more localized phenomena which are nevertheless linked to global environmental change. The data will be available on diskettes and CD-ROM (Compact Disk Read Only Memory) optical disks. Initially 2 CD-ROMs will contain the global and regional data sets, however, given the volume of data available and being generated annually, there is certainly the possibility of data on future CD-ROM's. The encyclopedia will operate on PC compatible microcomputer platforms in general use around the world. ESA

N93-23834# National Geophysical Data Center, Boulder, CO.
INTEGRATED GLOBAL ENVIRONMENTAL (GLOBAL CHANGE) DATA ACTIVITIES SUPPORT RESEARCHERS AND EDUCATORS **c45**
David A. Hastings, David M. Clark, and John J. Kineman *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1379-1382 (For primary document see N93-23748 08-43)
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The Global Change Data Base (GCDB) results from a cooperatively developed method of publishing peer reviewed data designed for integrated multivariate spatial analysis. The GCDB with accompanying documentation and accesss software lies entirely within the public domain. It is designed to further research, education, and overall awareness of the global environment; to provide beneficial feedback to enable the authors to enhance their own research and data development; and to provide a mechanism for scientists to share and receive credit for the intellectual content and

expression of their experimental designs, analyses, interpretations, and models of the global environment. The prime medium for distribution is CD-ROM (Compact Disk Read Only Mermory), though educational data sets are being prepared for distribution on floppy diskette, accompanied by a manual of exercises. ESA

N93-23835# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.
METEO DISC: SATELLITE CLOUD MOTION PRESENTATION BY INTERACTIVELY CONTROLLED VIDEO DISC FOR RESEARCH, TEACHING, AND TRAINING **c47**
Guenter Warnecke, Christian Zick, and Brian Toussaint *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1383-1385 (For primary document see N93-23748 08-43)
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Meteo Disc, an interactive, CAV (Constant Angular Velocity) videodisc for displaying motion scenes from meteorological satellite data, is introduced. The disc user can manipulate motion during its display. Linking the videodisc player with a PC provides the possibility of further scene manipulations, the development of a scene oriented knowledge base, and the preprogramming of presentations. ESA

N93-23836# Alfred-Wegener-Inst. for Polar Research, Bremerhaven (Germany).
INTER-COMPARISON OF SATELLITE DERIVED PASSIVE MICROWAVE ICE PRODUCTS
C. Garrity *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1387-1391 (For primary document see N93-23748 08-43)
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A Line Scan Camera (LSC) developed for polar and marine research has proven to be a valuable tool for validating passive microwave sea ice algorithms using brightness temperatures from the Special Sensor Microwave Imager (SSM/I). A quantitative comparison using 28 LSC flights and derived total ice concentrations for areas across the Weddell Sea showed an underestimation by three different algorithms. The underestimations varied depending on the algorithm used from 3 +/- 7 percent, followed by 8 +/- 5 percent, and 17 +/- 7 percent. ESA

N93-23837# Chalmers Univ. of Technology, Goeteborg (Sweden).
THE ODEN REAL TIME ICE MONITORING DEMONSTRATION
J. Askne and T. Thompson (Swedish Meteorological and Hydrological Inst., Norkoeping.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1393-1397 Sponsored by Swedish National Maritime Administration, Swedish Board for Space Activities, Swedish Polar Research Secretariat, and Wallenberg Foundation (For primary document see N93-23748 08-43)
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Oden is a Swedish icebreaker which was used for an international Arctic ocean expedition to the North Pole area during Aug. - Oct. 1991. The expedition was supported by a large number of different types of satellite information. Among these the most unique was the ERS-1 Synthetic Aperture Radar (SAR). However the satellites most used onboard Oden for operational applications were NOAA and Ocean-3, which could be received directly onboard in real time. The experience from monitoring of the ice conditions during the Arctic 91 expedition with main emphasis on the transfer of ERS-1 SAR image information to the Swedish icebreaker Oden is reported. Four sub-images and four contour maps were transferred in near real time using HF equipment. The main conclusion is that ERS-1 images can play an important role in the future to support ship navigation, field experiments etc. in the Arctic areas. It is however clear that improved communication systems covering the polar regions are required. ESA

N93-23838# National Space Development Agency, Saitama (Japan). Earth Observation Center.
DEVELOPMENT OF DATA SETS FOR THE ISY SEA SURFACE TEMPERATURE: MOS-1/MOS-1b DATA SETS
Korehiro Maeda and Hironori Maejima *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1399-1403 (For primary document see N93-23748 08-43)
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Both sea surface temperature and polar ice extent monitor items of the global warming. As a part of ISY (International Space Year) activity, NASDA (Japanese space agency) is contributing to sea surface temperature and polar ice extent. NASDA has developed various data sets using MOS-1/MOS-1b (Marine Observation Satellites), truth data and other satellite data. Some examples of data sets for sea surface temperature are presented. ESA

N93-23839# Iwate Univ., Morioka (Japan). Dept. of Computer Science.
ISY SEA SURFACE TEMPERATURE VALIDATION TEST PROGRAM IN MUTSU BAY (JAPAN)
R. Yokoyama, S. Tanba, T. Souma, H. Maejima (National Space Development Agency, Saitama, Japan.), and K. Maeda (National Space Development Agency, Saitama, Japan.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1405-1410 Sponsored in part by NASDA (For primary document see N93-23748 08-43)
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An accuracy validation test project for the Sea Surface Temperature (SST) estimation by satellite data in Mutsu bay (Japan), undertaken as part of the International Space Year (ISY), is reported. The sea and air truth data are provided by the four observation systems operated by independent organizations: Mutsu Bay Automatic Buoy System (MBABS); Automatic Meteorological Data Acquisition System (AMeDAS); Sea Surface Temperature Profiler Buoy (SSTPB); Radio Sonde Observation System (RSOS). The satellite SST is combined with the sea truth SST by MBABS to form matchups for the validation test. Their temporal and spatial coincidences are guaranteed to be within 30 minutes and one pixel resolution, respectively. The data of AMeDAS, SSTPB and RSOS can be effectively referred in the error analysis of the SST estimation. ESA

N93-23840# United Nations Educational, Scientific and Cultural Organization, Paris (France). Natural Science Sector.
UNESCO REMOTE SENSING AND GIS ACTIVITIES IN THE INTERNATIONAL SPACE YEAR
B. vonDroste, R. Missotten, and Q. Han *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1413-1416 (For primary document see N93-23748 08-43)
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UNESCO (United Nations Education, Science and Culture Organization) makes best possible use of new advances in technology, in particular of remote sensing and GIS (Geographic Information Systems), to enhance international cooperative effort to overcome unsustainability in the use of natural resources and further deterioration of natural and cultural heritage. UNESCO's main remote sensing and GIS activities are described, structured along four themes: study of ocean and coastal zones; ecological and hydrological research in the MAB (Man and the Biosphere) program and IHP (International Hydrological Program); monitoring hazards and risk management; education, training and capacity building. UNESCO actively promotes the use of remote sensing and GIS in ecosystem conservation. The 300 UNESCO designated biosphere reserves in 75 countries represent a variety of ecosystem types which provide a network for the use of GIS and remote sensing in studying environmental changes and generating information for decision makers to address resource development problems. ESA

N93-23841# United Nations, New York, NY. Outer Space Office.
SPACE ACTIVITIES AND ENVIRONMENTAL PROTECTION: ROLE OF THE UNITED NATIONS **c45**
N. Jasentuliyana and Ralph Chipman *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1417-1422 (For primary document see N93-23748 08-43)
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The United Nations (UN) primary forum for international discussions on space activities and the environment is the General Assembly's Committee on the Peaceful Uses of Outer Space, for which the Office for Outer Space serves as the secretariat. Other elements of the UN system are also concerned with the use of space technology for monitoring the environment. The work of the UN relating to space activities and the environment focuses on two areas: the promotion of international cooperation in the use of space technology for monitoring the terrestrial environment; and working to ensure that space activities do not themselves cause damage to the space or Earth environment. In the use of space technology for monitoring the Earth environment, the Office for Outer Space and the Committee on the Peaceful Uses of Outer Space play a modest role, generally in cooperation with the specialized agencies and other international, regional and national organizations. In the second area, that of ensuring that space activities do not harm the environment, the UN and the Committee in the Peaceful Uses of Outer Space play a much more central role.
ESA

N93-23842# World Meteorological Organization, Geneva (Switzerland).
PROGRAMMES AND STRATEGY FOR THE WORLD METEOROLOGICAL ORGANIZATION WITH RESPECT TO EARTH OBSERVATION FROM SPACE
G. O. P. Obasi *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1423-1428 (For primary document see N93-23748 08-43)
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The operational and research facets of several World Meteorological Organization (WMO) programs are highlighted. The operational World Weather Watch space observing system includes both geostationary and Sun synchronous polar orbiting satellites. The satellites are utilized for remote observations as well as communications and location finding purposes. Present components and future plans are summarized. The international cooperation amongst satellite operators, international organizations and programs are discussed. The increasing worldwide attention to climate issues led WMO to join force with the Intergovernmental Oceanographic Commission (IOC) of UNESCO (United Nations Education, Science and Culture Organization), the UN Environment Program (UNEP) and ICSU (International Council of Scientific Unions) to organize the implementation of a Global Climate Observing System (GCOS). The concept of GCOS and the objectives it serves in all aspects of the World Climate Program are summarized.
ESA

N93-23843# Commission of the European Communities, Brussels (Belgium). Joint Research Center.
EARTH OBSERVATION PROGRAMMES AND PLANS OF THE COMMISSION OF THE EUROPEAN COMMUNITIES (CEC)
Jean-Pierre Contzen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1429-1433 (For primary document see N93-23748 08-43)
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Highlights of Earth observation research activities of the Commission of the European Communities (CEC) are summarized. An account is given of the work performed in the area of remote sensing applications for environment and Earth resources by the Joint Research Centre (JRC) of the CEC. The CEC's role as a participant in the Global Change Research program is described. Joint projects in the field of environment and Earth observation between the ESA and the CEC are reported. Research and development shared cost action programs and the Earth observation activities supported by other Community policies are described. Future plans of research at the JRC are summarized.
ESA

N93-23844*# National Aeronautics and Space Administration, Washington, DC.
NEW DEVELOPMENTS IN THE COORDINATION OF EARTH OBSERVATION FROM SPACE ACTIVITIES: THE ROLE OF THE COMMITTEE ON EARTH OBSERVATIONS SATELLITES (CEOS)
B. Smith (National Environmental Satellite Service, Washington, DC.), L. Moodie (National Environmental Satellite Service, Washington, DC.), L. Shaffer, D. Williams (British National Space Centre, London, England.), and I. Revah (Centre National d'Etudes Spatiales, Paris, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1435-1437 (For primary document see N93-23748 08-43)
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The Committee on Earth Observations Satellites (CEOS) is outlined and the dynamics of the expanded CEOS with its increased focus on activities related to global climate change are examined. The participation of affiliate organizations at the Dec. 1991 Plenary is highlighted. The roles and current activities of constituted CEOS Working Groups on Data and on Sensor Calibration and Performance Validation are examined. The status of CEOS deliberations in Earth observation data policy is examined. The expanded CEOS is believed to be well suited to carry forward and help further the legacy already well established in the myriad of Earth observation activities associated with the 1992 International Space Year.
ESA

N93-23845*# National Aeronautics and Space Administration, Washington, DC.
MISSION TO PLANET EARTH
Gregory S. Wilson and Peter W. Backlund *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1439-1442 (For primary document see N93-23748 08-43)
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Mission to Planet Earth (MTPE) is NASA's concept for an international science program to produce the understanding needed to predict changes in the Earth's environment. NASA and its interagency and international partners will place satellites carrying advanced sensors in strategic Earth orbits to gather multidisciplinary data. A sophisticated data system will process and archive an unprecedented amount of information about the Earth and how it works as a system. Increased understanding of the Earth system is a basic human responsibility, a prerequisite to informed management of the planet's resources and to the preservation of the global environment. An overview of the MTPE, flight programs, data and information systems, interdisciplinary research efforts, and international coordination, is presented.
ESA

N93-23846# National Space Development Agency, Tokyo (Japan).
NASDA'S EARTH OBSERVING PROGRAMS AND THE CONTRIBUTION TO RESOLVING GLOBAL ENVIRONMENT PROGRAMS
Masato Yamano and Tasuku Tanaka *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1443-1448 (For primary document see N93-23748 08-43)
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'Mission to Planet Earth' can be considered as one of the two main space activities in the 21st century along with Mission from Planet Earth. One of the most significant scientific assessments for the global environment problems so far is 'Climate Change', the IPCC (Intergovernmental Panel on Climate Change) Scientific Report. The expected characteristics of the remote sensing are discussed based on the IPCC report. NASDA current activities in meteorology, marine observation, Earth resources, tropical rainfall

measurement, and data acquisition and processing are reviewed. The necessary measures for promoting 'Mission to Planet Earth' in the future are discussed. ESA

N93-23847# Canadian Space Agency, Ottawa (Ontario). Research and Applications Sector.

CANADIAN EARTH OBSERVATION PROGRAM

Garry M. Lindberg and Lyn McNutt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1449-1452 (For primary document see N93-23748 08-43)

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The Earth observation programs supported by the Canadian Space Agency (CSA) are discussed. These include the RADARSAT program, the development and operation of the Wind Imaging Interferometer (WIND 2) on the Upper Atmosphere Research Satellite (UARS), the development of the Measurement of Pollution in the Troposhere (MOPITT) instrument, and the operation of a ground receiving network covering most of North America. CSA sponsored activities undertaken as part of the Space Agency Forum of the International Space Year are described: the Interactive Global Change Encyclopedia, GEOSCOPE; the electronic atlas of North Atlantic Productivity, part of the Productivity of the Global Ocean Project; and the Canadian Ozone Experiment (CANOZE 7) and the International NO2 Intercomparison Experiment, both part of the Polar Stratospheric Ozone Project. ESA

N93-23848# British National Space Centre, London (England).

UNITED KINGDOM EARTH OBSERVATION PROGRAMME

Arthur Pryor *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1453-1456 (For primary document see N93-23748 08-43)

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The United Kingdom (UK) space progam is focused primarily on the Earth observation missions of the ESA. The UK national program complements ESA participation by funding announcement of opportunity instruments and preliminary technology development. Another aim is to sensitize users to the services which can be provided from space. Major challenges lie ahead in the area of data handling. The UK views data as a resource with a 'value', but the international exchange of research data must be encouraged. Data must also be held in a form which is accessible and comprehensible to a variety of interdisciplinary users. ESA

N93-23849# Italian Space Agency, Rome.

THE CONTRIBUTION OF THE ITALIAN SPACE AGENCY TO THE ESTABLISHMENT OF SPACE SERVICES FOR THE CHANGING EARTH

Luciano Guerriero *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1457-1460 (For primary document see N93-23748 08-43)

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The ASI (Italian space agency) activities in the field of Earth observation are reviewed. As for the space segment, most activities refer to the paticipation in European international programs. However, national activities at both satellite and instrument level are pursued. The ground segment activities include operations of facilities for remote sensed data processing and archiving, and for space geodesy, as well as technological developments and support to the national scientific community. An Earth observation world information center is being defined in cooperation with the other G7 countries, in response to the user needs for easy access to the worldwide system for data centers and networks being depolyed by the most industrialized countries to face the global change problem. ESA

N93-23850# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany).

EUMETSAT PRACTICE FOR PROTECTION OF ITS SATELLITE DATA **c84**

Volker Thiem *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1467-1470 (For primary document see N93-23748 08-43)

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EUMETSAT, an international organization funded through 16 European Member States and their national meteorological services, is introduced and its objectives, its data policy and the means to monitor this policy (protection of data use) are reviewed. Protection of data use can be achieved by technical and legal means. The technical issue is comparatively simple. The legal issue is complex. Current national and international legislation and jurisprudence are not prepared to provide clear and unambiguous answers to the questions raised. EUMETSAT therefore decided to amend its Convention to provide for clear legal protection. ESA

N93-23851# SPOT Image Corp., Toulouse (France).

PROTECTION OF SPOT DATA AND DERIVED PRODUCTS UNDER PRIVATE AGREEMENTS, THE LAW AND INTERNATIONAL CONVENTIONS **c84**

Luc Dufresne *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1471-1475 Presented at Colloquium on Legal Aspects of the Use of Satellite Remote Sensing Data in Europe, Munich, Germany, 11 Mar. 1992 (For primary document see N93-23748 08-43)

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The promotion, distribution, and worldwide sale of SPOT satellite data, and associated services, are outlined, and the protection of SPOT data, scenes and products, as arising from the following sources, is described: the copyright existing under French law; the acts against unfair competition in force throughout the world; special provisions set in agreements signed with sublicensees and distributors. The legal environment is concluded to be satisfactory because the SPOT data, scenes and products appear to benefit from significant protection under the law and international conventions dealing with copyright. The concept of copyright is suggested as the best solution for further directives. ESA

N93-23852*# National Aeronautics and Space Administration, Washington, DC.

US DATA POLICY FOR EARTH OBSERVATION FROM SPACE **c84**

Lisa Robock Shaffer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1477-1481 (For primary document see N93-23748 08-43)

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Distribution of data from U.S. Earth observations satellites is subject to different data policies and regulations depending on whether the systems in question are operational or experimental. Specific laws, regulations, and policies are in place for the distribution of satellite data from the National Oceanic and Atmospheric Administration (NOAA) operational environmental satellites and from NASA experimental systems. There is a government wide policy for exchange of data for global change research. For the Earth Observing System (EOS) and its international partner programs, a set of data exchange principles is nearing completion. The debate over the future of the LANDSAT program in the U.S. will impact policy for the programs, but the outcome of the debate is not yet known. ESA

N93-23853# Paris IX Univ., Dauphine (France).

CONDITIONS OF ACCESS TO EARTH OBSERVATION DATA: LEGAL ASPECTS [PRESENTATION DE L'ETUDE CEE RELATIVE AUX ASPECTS JURIDIQUES DE LA TELEDETECTION] **c84**

Philippe Gaudrat *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1483-1494 In FRENCH (For primary document see N93-23748 08-43)

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A detailed EEC (European Economic Community) study on legal aspects of remote sensing, the term particularly reserved for Earth observation for environment management, is presented. Ownership and marketing of Earth observation data are discussed. The protection of raw data and the protection of processed data are analyzed. ESA

N93-23854# United Nations Educational, Scientific and Cultural Organization, Paris (France). Society for the Study of Law and Policy on Space Utilization.

SATELLITE DATA PROTECTION FROM THE POINT OF VIEW OF A DATA USER: PREPARATION FOR FULL UTILIZATION OF REMOTE SENSING TECHNOLOGY c82

Kumon Tokumaru *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1495-1500 (For primary document see N93-23748 08-43)

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The role of UNESCO (United Nations Education, Science and Culture Organization) in remote sensing activities is outlined, and a discussion on the protection of satellite data for the operationalization of remote sensing technology, with representation of data users or future data users in developing countries, is presented. Some legal aspects of the use of satellite remote sensing data regarding data protection and processed data distribution and reproduction (covering copyrights) are discussed. ESA

N93-23855# Max-Planck-Inst. for Foreign and International Patent, Copyright and Competition Law, Munich (Germany).

INTERNATIONAL LAW PERSPECTIVE ON ESTABLISHING A EUROPEAN REGULATION WITH REGARD TO THE LEGAL PROTECTION OF THE USE OF SATELLITE REMOTE SENSING DATA c84

Thomas K. Dreier *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1501-1504 (For primary document see N93-23748 08-43)

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The need of legal protection by those engaged in satellite remote sensing activities, to cover the investment they have made, is addressed. This protection would have to contain a certain number of limitations balancing proprietary interests and the free flow of an unhindered access to information. An overview of existing legal protection reveals that both trade secret and copyright protection show serious shortcomings in providing appropriate protection for raw data. As far as enhanced products are concerned, the situation may look somewhat better. Some aspects of existing as well as of future legal protection are discussed and an examination is made for a suitable forum for achieving the internationally harmonized protection necessary in the field of satellite remote sensing. ESA

N93-23870# Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.

CORRELATION AND PREDICTION OF SNOW WATER EQUIVALENT FROM SNOW SENSORS

Bruce J. McGurk and David L. Azuma 1992 20 p

(PB93-127413; PSW-RP-211) Avail: CASI HC A03/MF A01

Since 1982, under an agreement between the California Department of Water Resources and the USDA Forest Service, snow sensors have been installed and operated in Forest Service-administered wilderness areas in the Sierra Nevada of California. Because analysis of snow water equivalent (SWE) data from these wilderness sensors would not be possible until just before they are due to be removed, 'surrogate pairs' of high- and low-elevation snow sensors were selected to determine whether correlation and prediction might be achieved. Surrogate pairs of sensors with between 5 and 15 years of concurrent data were selected, and correlation and regression were used to examine the statistical feasibility of SWE prediction after 'removal' of the wilderness sensors. Of the 10 pairs analyzed, two pairs achieved a correlation coefficient of 0.95 or greater. GRA

N93-24122 Laval Univ. (Quebec).

STUDIES ON DYNAMISM IN PHOTOGRAMMETRY Ph.D. Thesis

Zhengdong Shi 1990 205 p

Avail: Univ. Microfilms Order No. DANN68413

The objective of our research was to study the various dynamisms involved in photogrammetric operations, their sources, their error contributions and their solutions. Our thesis presents a detailed account of an extensive research on dynamism involved in the inputs and outputs of photogrammetric data acquisition and processing. The research study was carried out in three areas, namely dynamism due to photogrammetric imaging systems (e.g., cameras), dynamism due to object movements during exposures and dynamic distortions in instruments for plotting and mensuration. The dynamism due to the imaging systems has been studied theoretically. Analytical approaches for processing such imageries have been developed. Distortions caused by residual image motions due to the inclination of imaging sensors or unflatness of terrain have also been studied and the results indicate the relevancy of applying the developed approaches for the treatment of residual image motions. The dynamic distortions due to object movements have been studied both theoretically and practically. Mathematical models have been derived for estimating and correcting the dynamic distortions. The satellite imaging procedure around the earth was simulated in the laboratory by using an amateur camera to obtain stereo-photographic coverage along a great circle of a rotating globe. This delicate laboratory simulation was carried out to demonstrate the analyses, estimations and corrections for the involved dynamic distortions. The results show that dynamic distortions may be significant and by no means should one neglect their effects during data processing. The research concerning dynamic plotting distortions was performed on a Wild Aviotab TA10 digital plotting table attached to an analytical plotter (WILD BC1). A test procedure has been developed, which can be used on any type of digital plotting tables for detecting dynamic plotting distortions. The test results show that the dynamic plotting distortions are not only significant but also vary according to the following factors: plotting direction, figure location on the plotting table, shape of figure and plotting speed. All the mathematical models, test results and some relevant softwares developed through the research are presented in the thesis. The significance and potentials of the research are also presented. A bibliography is appended also. Dissert. Abstr.

N93-24140# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abt. Fernerkundungsanwendungen.

FOREST CLASSIFICATION AND DEAD WOOD MAPPING IN THE BAVARIAN FOREST NATIONAL PARK (GERMANY) USING LANDSAT TM AND DIGITAL ADDITIONAL DATA Thesis - Bonn Univ. [WALDKLASSIFIZIERUNG UND TOTHOLZKARTIERUNG IM NATIONALPARK BAYERISCHER WALD UNTER VERWENDUNG VON LANDSAT-TM-UND DIGITALEN ZUSATZDATEN]

Bodo Coenradie Jan. 1992 201 p In GERMAN Original contains color illustrations

(DLR-FB-92-10; ETN-93-93525) Avail: CASI HC A10/MF A03; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

In the Bavarian Forest National Park, a great variety of forest and vegetation communities is preserved. By using Thematic Mapper (TM) data, a classification of tree species and natural age classes is made. To take into account various small scale changes of forest type distributions, stand conditions, and illuminations, digital additional data (soil map, DEM (Digital Elevation Model)) is needed for stratification. The Czechoslovakian Republic intends to establish a Bohemian Forest National Park, close to the present Bavarian National Park. With regard to this, the contribution of satellite remote sensing is pointed out to assist planning and inventoring tasks. For this purpose, the classification result is extrapolated to a 30 by 30 km extended area, which includes possible protected Bohemian forests in future. As a part of a natural forest regeneration, dead wood as a consequence of windfalls and bark beetle damages remains in the forest. The National Park Office aspires to monitor these areas. A less expensive and less time consuming method for mapping dead wood by using TM data is developed. ESA

N93-24309# California Univ., La Jolla. Sea Grant Coll.

REMOTE SENSING AND GEOGRAPHIC INFORMATIONS SYSTEMS: IMPLICATIONS FOR GLOBAL MARINE FISHERIES

James J. Simpson (Scripps Institution of Oceanography, San Diego, CA.)

1992 28 p
(Grant NA89AA-D-SG-138; Proj. A/S-3)
(PB93-149409; T-CSGCP-025) Avail: CASI HC A03/MF A01

During the decade of the 1990's, several major fishing countries will launch satellites with improved, next generation ocean color sensors. This new technology, especially when combined with satellite-based estimates of sea surface temperature and geographic information systems, provides the possibility of near real-time support for the management and utilization of both pelagic and mid- to deep-water fisheries. This report reviews current state-of-the-art efforts in these areas, makes projections about anticipated uses of the new technologies in global marine fisheries, and evaluates the position of the United States relative to foreign fishing powers in the aforementioned areas. GRA

N93-24456# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna.
CESIUM-137 IN SOIL TEXTURE FRACTIONS AND ITS IMPACT ON CESIUM-137 SOIL-TO-PLANT TRANSFER
M. H. Gerzabek, S. A. Mohamad, and K. Mueck Jun. 1992 12 p
Repr. from Commun. Soil Sci. Plant Anal., v. 23, 1992 p 321-330
(OEFZS-4632; ETN-93-93452) Copyright Avail: CASI HC A03/MF A01

Field studies at two sites contaminated by the Chernobyl fallout, which showed cesium 137 (Cs-137) soil to plant transfer factors in wheat, rye, and potato, are reported. Transfer values ranged from 0.0017 (potato tuber) to 0.07 (wheat straw). Generally transfer coefficients in cereal grains and potato tubers were significantly below the values of the shoots. A comparison of the two sites led to the conclusion that for all plants investigated, Cs-137 transfer factors were higher in lower Austria (Calcic Chernozem) than in upper Austria (Eutric Cambisol). The specific activities of the texture fractions of the two soil types increased from sand to silt and clay. In the Calcic Chernozem the ratio of the Cs-137 from the silt fraction of the latter soil was clearly lower. Both results mainly were attributed to the differences between the soils according to the organic matter content of the silt fractions (the Calcic Chernozem being seven times higher). Therefore, the differences in the Cs-137 soil to plant transfer can be attributed partly to these soil characteristics. ESA

N93-24520# Los Alamos National Lab., NM.
FINAL REPORT ON THE FIRST STEP IN DISTRIBUTED REMOTE SENSING
G. H. Canavan Mar. 1993 13 p
(Contract W-7405-eng-36)
(DE93-007936; LA-12456) Avail: CASI HC A03/MF A01

Distributed remote sensing (DRS) has a number of promising applications; the World Laboratory's First Step in DRS documented and discussed them widely. Acceptance for DRS is growing in the U.S., the Former Soviet Republics (FSR's), and among global scientific, political, and military leaders. Ecological and defense applications were discussed in international meetings in Dubna and Erice. Its dual-use applications have solid support. The World Laboratory's Global Environmental Monitoring (GEM) project is appropriate, feasible, and an excellent vehicle for communication and cooperation, which could grow rapidly into a global effort. DOE

N93-24638# Kentucky Water Resources Research Inst., Lexington.
DEVELOPMENT OF MEMBRANE FILM FIBER OPTIC BASED SENSORS FOR THE REMOTE MONITORING OF THE QUALITY OF SURFACE AND GROUNDWATER
L. G. Bachas Aug. 1992 37 p Sponsored by Geolcgical Survey, Reston, VA
(Grant DI-14-08-0001-G-2021)
(PB93-150001; RR-184; USGS/G-2021-05) Avail: CASI HC A03/MF A01

The objective of the study was the development of chromo- and fluoroionophores and their subsequent use in sensors capable of surface and ground water monitoring. Several reagents (modified crown ethers and porphyrins) were synthesized based on principles of chemical recognition and used for metal and pH sensing. The modified crown ether reagents include a chromogenic or fluorogenic group. The selectivity of these reagents is controlled by the size of the crown ether ring and the type of the chromogenic or fluorogenic side-arm. In addition, a fluorogenic crown ether was synthesized that incorporates a fluorogenic sidearm and a per fluorinated carbon chain. The later was used to immobilize the fluoroionophore on PTFE membranes, which were placed at the tip of an optical fiberbundle. The configuration led to the development of a divalent ion-selective fiber optic sensor. Finally, cobalt(II)tetra(p-hydroxyphenyl)porphyrin, (Co(p-OH)TPP) was electropolymerized on the surface of optically transparent electrodes to form membranes composed of the polymerized (Co(p-OH)TPP) chromoionophore. These membrane phases, capable of molecular recognition, were used for the construction of fiber optic sensors. GRA

N93-24361# Technische Univ., Vienna (Austria). Inst. for Photogrammetry and Remote Sensing.
REMOTE SENSING EXPERIMENT FEM: A MULTISENSORAL DATASET FOR RADIOMETRIC AND GEOMETRIC ANALYSIS
R. Kalliany, W. Schneider (Bodenkultur Univ., Vienna, Austria.), K. Eerme (Academy of Sciences of the Estonian SSR, Tartu.), and O. Lebedyev (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 133-138 Sponsored by Bundesministerium fuer Wissenschaft und Forschung (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N93-22045# Sandia National Labs., Albuquerque, NM.
STRESS CALCULATION FOR THE SANDIA 34-METER WIND TURBINE USING THE LOCAL CIRCULATION METHOD AND TURBULENT WIND
B. Masse and H. Pastorel (Institut de Recherche de l'Hydro-Quebec, Varennes.) Nov. 1992 108 p
(Contract DE-AC04-76DP-00789)
(DE93-004480; SAND-91-7012) Avail: CASI HC A06/MF A02

Stress calculation for wind turbine blades is an important task for the manufacturers of wind turbines. A good prediction of stress level is required to tabulate the fatigue life of the rotor. Design of critical blade joints is based on such calculations. Aerodynamic loads and atmospheric turbulence were identified as important factors in estimating fatigue damage. A stress estimate procedure and its application to the Sandia/DOE 34-meter wind turbine are described. The procedure uses the computer code developed at IREQ (MCL) for aerodynamic load calculation including atmospheric turbulence. Aerodynamic loads are decomposed into modal components and applied to structures using the finite element program NASTRAN. Rotating modes are computed as a linear composition of stationary modes. The stress distributions as functions of frequency are extracted from the modal frequency response for critical locations on the blade. Stress distributions are calculated for the first five harmonics of the rotational speed and for off-harmonic frequencies. Calculated stress amplitude spectra are compared with Malcolm's results and with test data. The results indicate that improved aerodynamic loading is obtained from MCL and that aeroelastic effects needs to be added to obtain better agreement. DOE

N93-22323# Midwest Research Inst., Golden, CO.
MARKET PENETRATION OF NEW ENERGY TECHNOLOGIES
D. J. Packey Feb. 1993 64 p
(Contract DE-AC02-83CH-10093)
(DE92-016409; NREL/TP-462-4860) Avail: CASI HC A04/MF A01

This report examines the characteristics, advantages, disadvantages, and, for some, the mathematical formulas of forecasting methods that can be used to forecast the market penetration of renewable energy technologies. Among the methods studied are subjective estimation, market surveys, historical analogy models, cost models, diffusion models, time-series models, and econometric models. Some of these forecasting methods are more effective than others at different developmental stages of new technologies. DOE

N93-22330# Horizon Data Corp., Reston, VA. Power Information Center.

INTERAGENCY ADVANCED POWER GROUP SOLAR PHOTOVOLTAIC PANEL FALL MEETING MINUTES

1992 90 p Meeting held in Cleveland, OH, 22 Oct. 1992

(Contract DE-AC01-90CE-90053)

(DE93-006188; CONF-9210284) Avail: CASI HC A05/MF A01

This report contains discussions on the following topics: Leaf, TPL, and Co-60 Gamma source testing facilities; in-house photovoltaic research effort; US Army's interest developing small thermophotovoltaic power source for a variety of missions; charging lead acid batteries with unregulated photovoltaic panels; testing of solar array panels for space applications; polycrystalline CuInSe2 and CdTe PV solar cells; and current activities in the US photovoltaic program. DOE

N93-22334# Midwest Research Inst., Golden, CO.

FULL VECTOR (3-D) INFLOW SIMULATION IN NATURAL AND WIND FARM ENVIRONMENTS USING AN EXPANDED VERSION OF THE SNLWIND (VEERS) TURBULENCE CODE

N. D. Kelley Nov. 1992 10 p Presented at the 12th American Society Mechanical Engineers Wind Energy Symposium, Houston, TX, 31 Jan. - 4 Feb. 1993

(Contract DE-AC02-83CH-10093)

(DE93-000041; NREL/TP-442-5225; CONF-930153-2) Avail: CASI HC A02/MF A01

We have recently expanded the numerical turbulence simulation (SNLWIND) developed by Veers to include all three components of the turbulent wind vector. We have also configured the code to simulate the characteristics of turbulent wind fields upwind and downwind of a large wind farm, as well as over uniform, flat terrain. Veers's original method only simulates the longitudinal component of the wind in neutral flow. This paper overviews the development of spectral distribution, spatial coherence, and cross correlation models used to expired the SNLWIND code to include the three components of the turbulent wind over a range of atmospheric stabilities. These models are based on extensive measurements of the turbulence characteristics immediately upwind and downwind of a large wind farm in San Gorgonio Pass, California. DOE

N93-22335# Midwest Research Inst., Golden, CO.

AN OVERVIEW OF DOE'S WIND TURBINE DEVELOPMENT PROGRAMS

A. S. Laxson, S. M. Hock, W. D. Musial, and P. R. Goldman (Department of Energy, Washington, DC.) Dec. 1992 7 p Presented at the Windpower 1992, Seattle, WA, 19-23 Oct. 1992

(Contract DE-AC02-83CH-10093)

(DE93-000044; NREL/TP-441-5245; CONF-921049-8) Avail: CASI HC A02/MF A01

The development of technologically advanced, higher efficiency wind turbines continues to be a high priority of the US wind industry. The United States Department of Energy (DOE) is conducting and sponsoring a range of programs aimed at assisting the wind industry with system design, development, and testing. The overall goal is to develop systems that can compete with conventional electric generation at $0.05/kWh at 5.8 m/s (13 mph sites) by the mid-1990s, and with fossil-fuel-based generators $0.04/kWh at 5.8 m/s sites by the year 2000. These goals will be achieved through several programs. The Value Engineered Turbine (VET) Program will promote the rapid development of US capability to manufacture wind turbines to take advantage of near-term market opportunities. These value-engineered turbines will stem from units with known and well-documented records of performance. The Advanced Wind Turbine Program will assist US industry to develop and integrate advanced technologies into utility-grade wind turbines for the near term (1993-1995), and to develop a new generation of innovative turbines for the year 2000. The Utility Wind Turbine Performance Verification Program, a collaborative agreement between the Electric Power Research Institute (EPRI) and DOE, will deploy and evaluate commercial-prototype wind turbines in typical utility operating environments to provide a bridge from development programs currently under way to commercial purchases of utility-grade wind turbines. DOE

N93-22414# Sandia National Labs., Albuquerque, NM.

DEVELOPMENT OF CPG DISH-STIRLING SYSTEMS FOR REMOTE POWER APPLICATIONS

I. Kubo (Cummins Power Generation, Inc., Columbus, IN.) and R. B. Diver 1992 16 p Presented at the 6th International Symposium on Solar Thermal Concentrating Technologies, Mojacar, Spain, 25 Sep. - 2 Oct. 1992

(Contract DE-AC04-76DP-00789)

(DE93-003251; SAND-92-2123C; CONF-920938-3) Avail: CASI HC A03/MF A01

Through a program sponsored by the US Department of Energy (DOE), Cummins Power Generation, Inc. (CPG) and Sandia National Laboratories (SNL) have entered into a joint venture to develop and commercialize economically competitive dish-Stirling systems for remote power applications. Sixteen systems, representing three generations of technology, will be developed, fielded, and tested in the Dish-Stirling Joint Venture Program (JVP). The JVP is funded equally by a consortium led by CPG and by the DOE. After completion of the program, CPG's commercialization effort will continue with limited production expected to start in 1996. The program plan and the technology used in the JVP are outlined. The current status of the key system components, and the initial results of a system optimization study including current cost and performance estimates, are also provided. DOE

N93-22417# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.

COLORADO STATE UNIVERSITY PROGRAM FOR DEVELOPING, TESTING, EVALUATING AND OPTIMIZING SOLAR HEATING AND COOLING SYSTEMS

Jan. 1993 55 p

(Contract DE-FG02-86SF-16306)

(DE93-005795; DOE/SF-16306/34) Avail: CASI HC A04/MF A01

This program includes six tasks. The tasks are as follows: (1) a project measuring the performance of unique solar system components; (2) a project to develop a methodology for determining annual performance ratings of solar domestic hot water systems; (3) a project that will identify, analyze, design, build, and experimentally evaluate SDHW systems incorporating advanced concepts and components; (4) a liquid desiccant cooling system development project; (5) a project that will perform TRNSYS simulations to determine potential energy savings for desiccant cooling systems, especially in humid climates; and (6) a management task. The objectives and progress in each task are described. DOE

N93-22532# Sandia National Labs., Albuquerque, NM.

THIN SILICON SOLAR CELLS

R. B. Hall (Astropower, Inc., Newark, DE.), C. Bacon (Astropower, Inc., Newark, DE.), V. DiReda (Astropower, Inc., Newark, DE.), D. H. Ford (Astropower, Inc., Newark, DE.), A. E. Ingram (Astropower, Inc., Newark, DE.), J. Cotter (Astropower, Inc., Newark, DE.), T. Hughes-Lampros (Astropower, Inc., Newark, DE.), J. A. Rand (Astropower, Inc., Newark, DE.), T. R. Ruffins (Astropower, Inc., Newark, DE.), and A. M. Barnett (Astropower, Inc., Newark, DE.) Dec. 1992 40 p

(Contract DE-AC04-76DP-00789)

(DE93-007420; SAND-92-7012) Avail: CASI HC A03/MF A01

The silicon-film design achieves high performance by using a dun silicon layer and incorporating light trapping. Optimally designed thin crystalline solar cells (less than 50 microns thick) have performance advantages over conventional thick devices. The high-performance silicon-film design employs a metallurgical barrier between the low-cost substrate and the thin silicon layer. Light trapping properties of silicon-film on ceramic solar cells are presented and analyzed. Recent advances in process development are described here. DOE

N93-22535# Energy Research Corp., Danbury, CT.

NON-PROPRIETARY STACK RESEARCH

C. Yuh Jul. 1992 13 p

(Contract DE-AC21-90MC-27168)

(DE93-007523; DOE/MC-27168/3188) Avail: CASI HC A03/MF A01

Ohmic resistance loss in a state-of-the-art carbonate fuel cell contributes about 65 mV loss at BOL (beginning-of-life). It may increase to about as much as 145 mV after 40,000 hours. Its reduction will offer further improvement in fuel cell power plant efficiency. The important resistance

contributing elements/interfaces are illustrated in Figure 1. The majority of the ohmic loss is attributed to electrolyte matrix (ionic) and cathode-side hardware (electronic). The ohmic loss due to electrodes and anode-side hardware can generally be neglected. The matrix ionic resistance is influenced by many factors: electrolyte conductivity, matrix porosity, tortuosity, electrolyte fill level and matrix thickness. At present, matrix contributes to greater than 300 m ohm cm(exp 2) (greater than 70 percent of the total cell ohmic resistance) and is the major resistance contributor. The oxide formed at the cathode-CCC (cathode current collector) interface is the major cause of the cathode-side hardware resistance (contributing about 60 m ohm cm(exp 2)). For carbonate fuel cell to be economically viable, a 40,000h life is needed. Therefore, resistance stability for such a long-term operation is very important. Based on the above discussion, more understanding on ohmic resistance, particularly its increase, is needed for better recommending approaches to further reduce the ohmic resistance.
DOE

N93-22537# Sandia National Labs., Albuquerque, NM.
BATTERY COMPATIBILITY WITH PHOTOVOLTAIC CHARGE CONTROLLERS
S. R. Harrington (Ktech Corp., Albuquerque, NM.) and W. I. Bower 1992 7 p Presented at the DOE Review/G-2 Experiment, Upton, NY, 14-15 Jan. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005373; SAND-92-2501C; CONF-920152-2) Avail: CASI HC A02/MF A01

Photovoltaic (PV) systems offer a cost-effective solution to provide electrical power for a wide variety of applications, with battery performance playing a major role in their success. Some of the results of an industry meeting regarding battery specifications and ratings that photovoltaic system designers require, but do not typically have available to them are presented. Communications between the PV industry and the battery industry regarding appropriate specifications were uncoordinated and poor in the past. The effort under way involving the PV industry and battery manufacturers is discussed and a working draft of specifications to develop and outline the information sorely needed on batteries is provided. The development of this information is referred to as 'Application Notes for Batteries in Photovoltaic Systems.' The content of these 'notes' was compiled from various sources, including the input from the results of a survey on battery use in the photovoltaic industry. Only lead-acid batteries are discussed.
DOE

N93-22750# Institute of Energy Conversion, Newark, NJ.
STABLE, HIGH-EFFICIENCY AMORPHOUS SILICON SOLAR CELLS WITH LOW HYDROGEN CONTENT
C. M. Fortmann and S. S. Hegedus Dec. 1992 70 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE93-000049; NREL/TP-451-5191) Avail: CASI HC A04/MF A01

Results and conclusions obtained during the investigation of amorphous silicon, amorphous silicon based alloy materials, and solar cells fabricated by photo-chemical vapor and glow discharge depositions are reported. Investigation of the effects of the hydrogen content in a-Si:H i-layers in amorphous silicon solar cells show that cells with lowered hydrogen content i-layers are more stable. A classical thermodynamic formulation of the Staebler-Wronski effect has been developed for standard solar cell operating temperatures and illuminations. Methods have been developed to extract a lumped equivalent circuit from the current voltage characteristic of a single junction solar cell in order to predict its behavior in a multijunction device.
DOE

N93-22873# Sandia National Labs., Albuquerque, NM.
DAMPING MEASUREMENTS FROM AN OPERATING WIND TURBINE: PRELIMINARY RESULTS AND PROCEDURES
G. H. James and T. G. Carne 1992 24 p Presented at the 12th ASMEE Wind Energy Symposium, Houston, TX, 31 Jan. - 4 Feb. 1993
(Contract DE-AC04-76DP-00789)
(DE93-005357; SAND-92-1565C; CONF-930153-3) Avail: CASI HC A03/MF A01

The Natural Excitation Technique (NEXT) extracts modal parameters from structures undergoing some natural excitation in which no measure of the excitation force is available. Preliminary damping results are presented for the first blade flatwise modes of the Sandia/DOE 34-m Test Bed (a Vertical Axis Wind Turbine) as a function of both wind speed and tip speed ratio. The current data set is to sparse to show a trend between damping and wind speed; however, a trend of higher damping for higher tip speed ratio is apparent. An estimate of the uncertainty of the data is provided. Several improvements to NEXT have been added and are discussed in this paper. These improvements include: the use of a single software environment, the addition of the complex mode indicator function, the partial removal of harmonics, time and frequency domain cross-correlation function calculation, windowing, variable ensemble size capability, filtering and data decimation, and visual convergence checking.
DOE

N93-22879*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
LUNAR ELECTRIC POWER SYSTEMS UTILIZING THE SP-100 REACTOR COUPLED TO DYNAMIC CONVERSION SYSTEMS Final Report
Richard B. Harty and Richard E. Durand Mar. 1993 69 p
(Contract NAS3-25808)
(NASA-CR-191023; NAS 1.26:191023; Rept-93RC-02316) Avail: CASI HC A04/MF A01

An integration study was performed by Rocketdyne under contract to NASA-LeRC. The study was concerned with coupling an SP-0100 reactor to either a Brayton or Stirling power conversion system. The application was for a surface power system to supply power requirements to a lunar base. A power level of 550 kWe was selected based on the NASA Space Exploration Initiative 90-day study. Reliability studies were initially performed to determine optimum power conversion redundancy. This study resulted in selecting three operating engines and one stand-by unit. Integration design studies indicated that either the Brayton or Stirling power conversion systems could be integrated with the PS-100 reactor. The Stirling system had an integration advantage because of smaller piping size and fewer components. The Stirling engine, however, is more complex and heavier than the Brayton rotating unit, which tends to off-set the Stirling integration advantage. From a performance consideration, the Brayton had a 9 percent mass advantage, and the Stirling had a 50 percent radiator advantage.
Author (revised)

N93-22890# Midwest Research Inst., Golden, CO.
CORECT: COMMITTEE ON RENEWABLE ENERGY COMMERCE AND TRADE, 1991
Dec. 1992 17 p
(Contract DE-AC02-83CH-10093)
(DE92-016436; DOE/CH-10093/176) Avail: CASI HC A03/MF A01

An overview of the activities of CORECT (Committee on Renewable Energy, Commerce and Trade) for 1991 is presented as a series of highlights and photographs of projects underway in Mexico, Guatemala, Montserrat, Indonesia, Thailand, Malaysia, and others.
DOE

N93-22927# Midwest Research Inst., Golden, CO.
CURRENT PERFORMANCE AND POTENTIAL IMPROVEMENTS IN SOLAR THERMAL INDUSTRIAL HEAT
M. J. Hale, T. Williams, and G. Barker Dec. 1992 9 p Presented at the International American Society of Mechanical Engineers/ASES (ASME/ASES) Joint Solar Energy Conference, Washington, DC, 4-9 Apr. 1993
(Contract DE-AC02-83CH-10093)
(DE93-000048; NREL/TP-432-5027; CONF-930435-4) Avail: CASI HC A02/MF A01

A representative current state-of-the-art system using parabolic trough technology was developed using data from a system recently installed in Tehachapi, California. A simulation model was used to estimate the annual energy output from the system at three different insolation locations. Based on discussions with industry personnel and within NREL, we identified a number of technology improvements that offer the potential for increasing the energy performance and reducing the energy-cost of the baseline system. The technology improvements modeled included an evacuated-tube receiver, an antireflective coating on the receiver tube, an improved absorber material, a cleaner reflecting surface, a reflecting surface that can withstand contact cleaning, and two silver reflectors. The properties associated with the improvements were incorporated into the model simulation at the three

insolation locations to determine if there were any performance gains. The results showed that there was a potential for a more than 50 percent improvement in the annual energy delivered by a 2677 sq m system incorporating a combination of the enumerated technology improvements. We discuss the commercial and technological status of each design improvement and present performance predictions for the trough-design improvements. DOE

N93-22934# Department of Energy, Morgantown, WV. Technology Center.

PROCEEDINGS OF THE FOURTH ANNUAL FUEL CELLS CONTRACTORS REVIEW MEETING

W. J. Huber, ed. Jul. 1992 176 p Meeting held in Morgantown, WV, 14-15 Jul. 1992

(DE92-001290; DOE/METC-92-6127; CONF-920748) Avail: CASI HC A09/MF A02

The objective of the program was to develop the essential technology for private sector commercialization of various fuel cell electrical generation systems, which promise high fuel efficiencies (40-60 percent), possibilities for cogeneration, modularity, possible urban siting, and low emissions. The purpose of this meeting was to provide the R and D participants in the DOE/Fossil Energy-sponsored Fuel Cells Program with a forum. With the near commercialization of phosphoric acid fuel cells, major emphasis was on molten carbonate and solid oxide fuel cells. Twenty-two papers were given in 3 formal sessions: molten carbonate fuel cells; solid oxide fuel cells; and systems and phosphoric acid. In addition, the proceedings also include a welcome to METC address and comments on the Fuel Cells Program from the viewpoint of EPRI and DOE's Vehicular Fuel Cell Program. Separate abstracts have been prepared. DOE

N93-22956# Imatran Voima Oy, Helsinki (Finland).

PHOTOVOLTAIC EVALUATION STUDY

G. Johnson, M. Heikkilae, T. Melasuo, and S. Spanner 1992 204 p

(DE93-761330; IVO-A-03/92) Avail: CASI HC A10/MF A03

Realizing the value and potential of PV-power as well as the growing need for increased cooperation and sharing of knowledge in the field of photovoltaics, FINNIDA and UNICEF decided to undertake a study of selected PV-projects. There were two main objectives for the study: To gather, compile, evaluate and share information on the photovoltaic technology appropriate to developing countries, and to promote the interest and competence of Finnish research institutes, consultants and manufacturers in photovoltaic development. For this purpose a joint evaluation of significant, primarily UN-supported projects providing for the basic needs of rural communities was undertaken. The Gambia and Kenya offered a variety of such projects, and were chosen as target countries for the study. The projects were chosen to be both comparable and complimentary. In the Gambia, the main subject was a partially integrated health and telecommunications project, but a long-operating drinking water pumping system was also studied. In Kenya, a health project in the Turkana area was examined, and also a large scale water pumping installation for fish farming. Field visits were made in order to verify and supplement the data gathered through document research and earlier investigations. Individual data gathering sheets for the project form the core of this study and are intended to give the necessary information in an organized and accessible format. The findings could practically be condensed into one sentence: PV-systems work very well, if properly designed and installed, but the resources and requirements of the recipients must be considered to a higher degree. DOE

N93-22957# Institute of Energy Economics of Japan.

FUTURE TRENDS IN POWER GENERATION COST BY POWER RESOURCE

25 Aug. 1992 28 p

(DE93-761825; ETDE/JP-MF-93761825) Avail: CASI HC A03/MF A01

The Japan Energy Economy Research Institute has been evaluating power generation cost by each power resource every year focusing on nuclear power generation. The Institute is surveying the cost evaluations by power resources in France, Britain and the U.S.A., the nuclear generation advanced nations. The OECD is making power generation cost estimation using a hypothesis which uniforms basically the conditions varying in different member countries. In model power generation cost calculations conducted by the Ministry of International Trade and Industry of Japan, nuclear power generation is the most economical system in any fiscal year. According to recent calculations performed by the Japan Energy Economy Research Institute, the situation is such that it is difficult to distinguish the economical one from others among the power generation systems in terms of generation costs except for thermal power generation. Economic evaluations are given on estimated power generation costs based on construction costs for nuclear and thermal power plants, nuclear fuel cycling cost, and fuel cost data on petroleum, LNG and coal. With regard to the future trends, scenario analyses are made on generation costs, that assume fluctuations in fuel prices and construction costs, the important factors to give economic influence on power generation. DOE

N93-22958# New Energy and Industrial Technology Development Organization, Tokyo (Japan).

INVESTIGATION AND STUDY SCENARIOS TO INTRODUCE CO2 FIXATION TECHNOLOGIES IN THE ENERGY SECTOR

Mar. 1992 103 p

(DE93-761912; NEDO-ITE-9103) Avail: CASI HC A06/MF A02

The ultimate target of the study is to develop models which can evaluate scenarios for the future development of CO2 fixation technology from the aspect of its effect on Japan's energy supply/ demand structure and the CO2 reduction effect. An outline model is built and operated to study the function. Using the linear programming, the model is developed which can numerically grasp the effects of the following items on the energy supply/demand structure: energy supply, introduction of new energy, energy conservation measures, restrictions on CO2 emissions, introduction of CO2 emission penalty, introduction of CO2 fixation technologies, energy supply costs, etc. Estimation is trially made for 6 cases, that is, 3 cases each in 2000 and 2010; standard case (A), CO2 emission penalty case (B) and CO2 emission restrictions case (C), using one-year calculation in 2000 and 2010. CO2 fixation technology in volume to be introduced in 2000 is 40,000C tons (B) and 120,000C tons (C) in the electric utility industry, and 32,000C tons (B) and 92,000C tons (C) in the industry except electric utility. In case C, in particular, the gross CO2 emission from the primary energy to be selected for supply is with in 280 million tons. This is the same as in 2010. DOE

N93-22966# Pacific Northwest Lab., Richland, WA.

EVALUATION OF DIURNAL THERMAL ENERGY STORAGE COMBINED WITH COGENERATION SYSTEMS

S. Somasundaram, D. R. Brown, and M. K. Drost Nov. 1992 40 p

(Contract DE-AC06-76RL-01830)

(DE93-004798; PNL-8298) Avail: CASI HC A03/MF A01

This report describes the results of an evaluation of thermal energy storage (TES) integrated with simple gas turbine cogeneration systems. The TES system captures and stores thermal energy from the gas turbine exhaust for immediate or future generation of process heat. Integrating thermal energy storage with conventional cogeneration equipment increases the initial cost of the combined system; but, by decoupling electric power and process heat production, the system offers the following significant advantages: (1) electric power can be generated on demand, irrespective of the process heat load profile, thus increasing the value of the power produced; (2) although supplementary firing could be used to serve independently varying electric and process heat loads, this approach is inefficient. Integrating TES with cogeneration can serve the two independent loads while firing all fuel in the gas turbine. The study evaluated the cost of power produced by cogeneration and cogeneration/TES systems designed to serve a fixed process steam load. The value of the process steam was set at the levelized cost estimated for the steam from a conventional stand-alone boiler. Power costs for combustion turbine and combined-cycle power plants were also calculated for comparison. The results indicated that peak power production costs for the cogeneration/TES systems were between 25 and 40 percent lower than peak power costs estimated for a combustion turbine and between 15 and 35 percent lower than peak power costs estimated for a combined-cycle plant. The ranges reflect differences in the daily power production schedule and process steam pressure/temperature assumptions for the cases evaluated. Further cost reductions may result from optimization of current cogeneration/TES system designs and improvement in TES technology through future research and development. DOE

N93-22967# Sandia National Labs., Albuquerque, NM.
A SUMMARY OF RECENT ACTIVITIES AT THE NATIONAL SOLAR THERMAL TEST FACILITY
C. P. Cameron 1992 17 p Presented at the International American Society of Mechanical Engineers/ASES (ASME/ASES) Joint Solar Energy Conference, Washington, DC, 4-9 Apr. 1993
(Contract DE-AC04-76DP-00789)
(DE92-040969; SAND-92-1348C; CONF-930435-1) Avail: CASI HC A03/MF A01

The United States Department of Energy's National Solar Thermal Test Facility (NSTTF), located at Sandia National Laboratories in Albuquerque, New Mexico, is the major facility for testing of solar thermal components and systems in the United States. Since originally being constructed as the Central Receiver Test Facility in the late 1970's, its mission has been expanded to include distributed receiver technologies, and it now includes line-focus and point-focus collectors, two solar furnaces, and an engine test facility. In addition, the unique capabilities of the facility have been applied to a wide variety of tests unrelated to solar energy, but using the intense heat from concentrated solar radiation or using the large-scale optical systems at the site. In this paper, current activities at the NSTTF are summarized, with an emphasis on activities that have not been described elsewhere. DOE

N93-22971# Technical Research Centre of Finland, Espoo. Electrical and Automation Engineering Lab.
WIND POWER PLANTS IN THE WEATHER CONDITIONS OF NORTHERN FINLAND
Georg Bohmeke 1992 95 p
(DE93-752927; VTT-TIED-1354) Avail: CASI HC A05/MF A01

Lappland's fells and highlands feature a notable wind power potential due to special meteorological circumstances. The wind power plants for these sites must be equipped with special means against icing and low temperatures. Icing events monitored on a small test machine are described and compared with general load assumptions. Different means of ice detection and ice removal from rotor blades are presented. Low temperature and anti-icing requirements for wind power plant components and operation control are discussed. DOE

N93-22978# Oak Ridge National Lab., TN.
HEAT PUMP TECHNOLOGY: RESPONDING TO NEW OPPORTUNITIES
V. D. Baxter, F. A. Creswick, and W. K. Snelson 1993 21 p Presented at the 4th International Energy Agency Heat Pump Conference: Heat Pump for Energy Efficiency and Environmental Progress, Maastricht, Netherlands, 26-29 Apr. 1993
(Contract DE-AC05-84OR-21400)
(DE93-005939; CONF-930427-1) Avail: CASI HC A03/MF A01

This paper provides an update on advanced heat pump research and development activities in the United States and Canada. These research programs are directed toward the development of viable alternatives to HCFC-22 for heat pump and air-conditioning applications. The HCFC phaseout provides an opportunity to develop advanced refrigeration equipment for the new refrigerants which has higher energy efficiency than current heat pump systems. Programs are underway in both industry and government laboratories and are characterized by close collaboration between major manufacturers and government agencies to plan and execute the research. Under the general area of thermally activated heat pump technology, there are several cooperative early-commercialization activities being conducted on gas-fired heat pumps and chillers by government, HVAC industry, and gas utility organizations. DOE

N93-22983# Oak Ridge National Lab., TN.
AN ENVIRONMENTAL RATING FOR HEAT PUMP EQUIPMENT
P. J. Hughes 1992 15 p Presented at the Canada/United States Joint Workshop on Heat Pump Standards for Performance Rating, Toronto, Ontario, 7-8 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004526; CONF-921238-1) Avail: CASI HC A03/MF A01

The major federal and state regulatory trends that may affect heat pump markets are reviewed. Then the confluence of federal and state regulation, and what it may mean for heat pump markets, is discussed. The conclusion reached, and therefore the assumption for the rest of the paper, is that state regulators will increasingly be managing the environmental impacts associated with alternative heating, cooling, and water heating methods within the framework of Integrated Resource Planning (IRP). The input needs of IRP are reviewed, and some shortcomings of existing rating procedures for providing the IRP inputs are identified. Finally, the paper concludes with a brief suggestion on course of action. DOE

N93-22988# Pacific Northwest Lab., Richland, WA.
GRIDDED STATE MAPS OF WIND ELECTRIC POTENTIAL
M. N. Schwartz, D. L. Elliott, and G. L. Gower Oct. 1992 10 p Presented at the Windpower 1992, Seattle, WA, 19-23 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004556; PNL-SA-21320; CONF-921049-7) Avail: CASI HC A02/MF A01

Estimates of wind electric potential and available windy land area in the contiguous United States, calculated in 1991, were revised by incorporating actual data on the distribution of environmental exclusion areas where wind energy development would be prohibited or severely restricted. The new gridded data base with actual environmental exclusion areas, in combination with a 'moderate' land-use scenario, is the basis for developing the first gridded maps of available windy land and wind electric potential. Gridded maps for the 48 contiguous states show the estimated windy land area and electric potential for each grid cell (1/40 latitude by 1/30 longitude). These new maps show the distribution of the estimated wind electric potential and available windy land within an individual state, unlike previous national maps that only show estimates of the total wind electric potential for the state as a whole. While changes for some individual states are fairly large (in percentage), on a national basis, the estimated windy land area and wind electric potential are only about 1 - 2 percent higher than estimated in 1991. DOE

N93-23018*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CHANGES IN IMPEDANCE OF Ni/Cd CELLS WITH VOLTAGE AND CYCLE LIFE
Margaret A. Reid Jul. 1992 12 p Presented at the Second International Symposium on Electrochemical Impedance Spectroscopy, Santa Barbara, CA, 12-17 Jul. 1992; sponsored by the Pennsylvania State Univ.
(RTOP 323-57-4B)
(NASA-TM-106105; E-7688; NAS 1.15:106105) Avail: CASI HC A03/MF A01

Impedances of aerospace design Super Ni/Cd cells are being measured as functions of voltage and number of cycles. The cells have been cycled over 4400 cycles to date. Analysis of the impedance data has been made using a number of equivalent circuits. The model giving the best fit over the whole range of voltage has a parallel circuit of a kinetic resistance and a constant phase element in series with the ohmic resistance. The values for the circuit elements have been treated as empirical parameters, and no attempt has been made as yet to correlate them with physical and chemical changes in the electrode. No significant changes have been seen as yet with the exception of a decrease in kinetic resistance at low states of charge in the first 500 cycles. Author

N93-23049# Energy Research Corp., Danbury, CT.
DESIGN OF GASIFIERS TO OPTIMIZE FUEL CELL SYSTEMS
Apr. 1992 11 p
(Contract DE-AC21-90MC-27227)
(DE93-000219; DOE/MC-27227/3135) Avail: CASI HC A03/MF A01

Phase 1 of Task 4.2 began this quarter with TGA testing of limestone, taconite, and K2CO3 as a gasification catalysts with Illinois No. 6 coal. These tests are designed to compare the reactivities of these catalysts using Illinois No. 6 coal. In all cases, the molar equivalent ratioof catalyst to fixed carbon was 0.12, so that for K(+) the molar ratio was K/FC = 0.12, for Ca(2+) = 0.06, and for Fe(3+) = 0.04 mols/mol. In this way the active sites on the coal structure (-COO(-)) are exposed to the same number of possible connections with mobile cations regardless of the choice of metallic element. The proximate analyses of the catalyzed samples and raw coal are shown. The TGA tests used a dry form of each catalyst at temperatures ranging from 700 to 800 C. Analysis of the data reveals that dry taconite alone provides essentially no catalytic activity. Dry limestone provides a slight improvement in reactivity; however this improvement is insignificant in comparison to the high reactivities obtained with a potassium catalyst. An impregnated potassium catalyst, introduced as a wood ash

leachate, was also tested. The negligible difference in reactivities of wood ash leachate and K2CO3 indicate that the potassium is as mobile dry, as it is impregnated, and therefore its chemical form is not a crucial issue. Further TGA testing is being conducted using Illinois No. 6 coal char impregnated with soluble Ca(2+) and Fe(3+.) By using soluble forms of the catalysts, more intimate contact between the coal and catalyst is expected. This may increase apparent reactivity. DOE

N93-23287# Westinghouse Electric Corp., Pittsburgh, PA. Advanced Energy Conversion Dept.

THE WESTINGHOUSE SOLID OXIDE FUEL CELL PROGRAM: CLEAN, EFFICIENT ENERGY FOR THE FUTURE

G. B. Gockley 1992 8 p Presented at the 9th Annual International Pittsburgh Coal Conference, Pittsburgh, PA, 12-16 Oct. 1992

(Contract DE-FC21-91MC-28055)

(DE93-003487; DOE/MC-28055/93/C0134; CONF-921037-9) Avail: CASI HC A02/MF A01

This paper provides an overview of the Westinghouse tubular SOFC technology and field testing program. The development program for the field testing was initiated in 1986 with a 400 W unit. This program has progressed to the installation and start-up in early 1992 of the 25 kill field unit at Rokko Island in Japan. In mid-1992 the second 25 kill field unit, a cogeneration system producing both ac electric power and intermediate pressure steam, will be delivered to the Joint Gas Utilities, a consortium of the Tokyo Gas Company and the Osaka Gas Company. This will be followed by the 20 kill SOFC unit to be supplied to Southern California Edison in early 1993. Future plans include the 100 kill Cogeneration Proof-of-Concept unit for the Southern California Gas Company which is scheduled for delivery in late 1993. Applications for SOFC technology range from on-site power generation for commercial second small industrial applications to dispersed generating plants and central station electric power generation. The design studies have included integrated coal gasification SOFC-steam turbine power plants. Installed capital costs of a 250 MW plant of this configuration compares favorably with the integrated coal gasification combined cycle plants. DOE

N93-23293# Sandia National Labs., Albuquerque, NM.

MONOLITHIC, SERIES CONNECTED GaAs PHOTOVOLTAIC POWER CONVERTERS FOR OPTOELECTRONIC COMPONENT APPLICATIONS

B. H. Rose Sep. 1992 91 p

(Contract DE-AC04-76DP-00789)

(DE93-004385; SAND-92-1534) Avail: CASI HC A05/MF A01

This report describes the features of monolithic, series connected photovoltaic converters which have been developed for applications where voltages are required that are higher than available using conventional single junction solar cells. These devices are intended to play a significant role in advanced weapon systems development. They are also appropriate for any other applications where electric power is needed in remote regions and electrical connection to the region is deemed detrimental for whatever reasons. Development of this technology at two outside contractors has been accomplished through competitive procurement in response to an internally generated Statement of Work. Detailed comparisons are made of data taken from converters of each type from both contractors. The primary advantage of these converters is that they are high voltage/low current devices compared to conventional single junction solar cells. This allows them to directly drive a wider range of loads without the necessity of power conditioning, such as provided by a transformer. Discussions of load analysis for given applications are included. DOE

N93-23302# Midwest Research Inst., Golden, CO.

THE PHOTOVOLTAIC MANUFACTURING TECHNOLOGY PROJECT, PHASE 1

Jul. 1992 9 p

(Contract DE-AC02-83CH-10093)

(DE92-010597; NREL/MK-411-4973-Phase-1) Avail: CASI HC A02/MF A01

The Phase 1 portion of the Photovoltaic Manufacturing Technology (PVMaT) Project, the problem identification phase, was completed in mid-1991. This work involved competitive bidding that was open to any U.S. firm with existing manufacturing capabilities, regardless of material or module design. In early 1991, subcontracts were awarded to 22 of approximately 40 bidders. Each subcontract was funded at a level of up to $50,000 and a duration of three months. The problems identified by the research in this phase of the program represent opportunities for industrial participants to improve their manufacturing processes, reduce manufacturing costs, increase product performance, or develop a foundation for scaling up U.S.-based manufacturing plant capacities. Many of these opportunities have since been detailed in the approaches that these organizations suggested for Phase 2 (the problem solution phase) research and development (R&D). It is not anticipated that any additional Phase 1 solicitation will be issued because Phase 1 was intended to help the U.S. Department of Energy (DOE) characterize the status and needs of the U.S. photovoltaic (PV) industry and encourage the industry to examine and prioritize required manufacturing line improvements. Phase 1 subcontracted research included five subcontractors working on flat-plate crystalline silicon technology, eleven working on flat-plate thin-film modules (one in thin-film crystalline silicon, six in amorphous silicon. and four in polycrystalline thin films), six working on concentrator systems, and two working on general equipment/production options. (Two of the participants each worked in two areas). DOE

N93-23303# Midwest Research Inst., Golden, CO.

PHOTOVOLTAICS PERFORMANCE AND RELIABILITY WORKSHOP

L. Mrig, ed. 1992 527 p Workshop held in Golden, CO, 16-18 Sep. 1992

(Contract DE-AC02-83CH-10093)

(DE93-000017; NREL/CP-411-5184; CONF-9209252) Avail: CASI HC A23/MF A04

This document consists of papers and viewgraphs compiled from the proceedings of a workshop held in September 1992. This workshop was the fifth in a series sponsored by NREL/DOE under the general subject areas of photovoltaic module testing and reliability. PV manufacturers, DOE laboratories, electric utilities, and others exchanged technical knowledge and field experience. The topics of cell and module characterization, module and system performance, materials and module durability/reliability research, solar radiation, and applications are discussed. DOE

N93-23304# Midwest Research Inst., Golden, CO.

EVALUATION OF SOLAR RADIATION MEASUREMENT SYSTEMS: EPRI/NREL Final Test Report

T. Stoffel, C. Riordan, and J. Bigger Nov. 1992 63 p

(Contract DE-AC02-83CH-10093)

(DE93-000020; NREL/TP-463-4771) Avail: CASI HC A04/MF A01

Measured solar radiation resource data are needed by electric utilities to evaluate the potential of renewable energy options like photovoltaics in their service territory. In this final test report, we document a cooperative project of the Electric Power Research Institute (EPRI) and the National Renewable Energy Laboratory (NREL) to compare available measurement system options for performing solar radiation resource assessments. We present the detailed results of a 6-month field comparison of thermopile-based pyranometer and pyrheliometer solar irradiance measurement systems with two different implementations of the rotating shadowband radiometer (RSR) concept installed at NREL's Solar Radiation Research Laboratory (SRRL) in Golden, Colorado. DOE

N93-23318# Sandia National Labs., Albuquerque, NM.

FATIGUE AND RELIABILITY ANALYSES FOR WIND TURBINES

H. J. Sutherland 1992 10 p Presented at the Fatigue Experts Conference, Golden, CO, 15 Oct. 1992

(Contract DE-AC04-76DP-00789)

(DE93-004497; SAND-92-2480C; CONF-9210253-1) Avail: CASI HC A02/MF A01

This paper presents a summary of two areas of research into the fatigue of wind turbine components at Sandia National Laboratories. The first area is the fatigue analysis of turbine components and the second is reliability analysis. For the former, current work is addressing the examination of experimental data in the time and frequency domain. Emphasis in this paper is directed at the determination of the 'high-stress' tail of the cycle count distribution. For the reliability analysis, research is quantifying the uncertainties and the inherent randomness associated with turbine performance and the prediction of service lifetimes. Both research areas are highlighted with typical results. DOE

N93-23360*# Mechanical Technology, Inc., Latham, NY.
HEAT PIPE FATIGUE TEST SPECIMEN: METALLURGICAL EVALUATION Topical Report, Oct. 1990 - 1991
Steven E. Walak, Michael J. Cronin, and Toni Grobstein (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Jan. 1992 37 p
(Contract NAS3-25463; RTOP 583-02-21)
(NASA-CR-189120; NAS 1.26:189120; MTI-91TR56) Avail: CASI HC A03/MF A01

An innovative creep/fatigue test was run to simulate the temperature, mechanical load, and sodium corrosion conditions expected in a heat pipe designed to supply thermal energy to a Stirling cycle power converter. A sodium-charged Inconel 718 heat pipe with a Nickel 200 screen wick was operated for 1090 hr at temperatures between 950 K (1250 F) and 1050 K (1430 F) while being subjected to creep and fatigue loads in a servo-hydraulic testing machine. After testing, the heat pipe was sectioned and examined using optical microscopy, scanning electron microscopy, and electron microprobe analysis with wavelength dispersive x-ray spectroscopy. The analysis concentrated on evaluating topographic, microstructural, and chemical changes in the sodium exposed surfaces of the heat pipe wall and wick. Surface changes in the evaporator, condenser, and adiabatic sections of the heat pipe were examined in an effort to correlate the changes with the expected sodium environment in the heat pipe. This report describes the setup, operating conditions, and analytical results of the sodium heat pipe fatigue test. Author (revised)

N93-23444 International Bank for Reconstruction and Development, Washington, DC.
SOLAR PUMPING: AN INTRODUCTION AND UPDATE ON THE TECHNOLOGY, PERFORMANCE, COSTS, AND ECONOMICS
Roy Barlow, Bernard McNelis, and Anthony Derrick 1993 164 p
(World Bank TP-168; ISBN-0-8213-2101-3; LC-92-21847) Copyright Avail: CASI HC A08; paper copy available from World Bank Publications, PO Box 7247-8619, Philadelphia, PA 19170-8619

Although the number of units in the field is still small, solar photovoltaic (PV) powered pumping systems offer many advantages over the more traditional technologies. Because there are few moving parts, maintenance is reduced to a minimum, and reliability is very high. Also, because the time of greatest water demand usually coincides with the maximum daily solar energy, the available pumping power is well matched to the demand. This guide is written for the potential user to give a simple background to PV pumping technology and to help to identify the situations in which solar pumping should be considered. The early chapters act as a guide to those unfamiliar with PV pumping, illustrating typical applications, and reviewing current technology. Following this are sections dealing with the range of currently available equipment and examining experience in the field. The final four sections cover the practical aspects of choosing a pumping system. This includes site evaluation and system sizing, a simple methodology for an economic assessment, and advice on procurement, installation, and maintenance. GRA

N93-23671# Midwest Research Inst., Golden, CO.
STATUS REPORT ON RENEWABLE ENERGY IN THE STATES
B. Swezey and K. Sinclair Dec. 1992 100 p
(Contract DE-AC02-83CH-10093)
(DE93-000032; NREL/TP-462-5175) Avail: CASI HC A05/MF A02

As the concept of integrated resource planning has spread among states and utilities, a reexamination of the role of renewable energy sources in the utility resource mix is taking place. This report documents the findings of a study of state regulatory commissions undertaken to: (1) help assess the state of knowledge and awareness about renewable energy resources and technologies; (2) assess the impacts of state policies on renewable energy development; and (3) identify important information needs. The key findings from this effort are: Renewable energy development has occurred only slowly over the last decade, and a small number of states account for the bulk of development. The development that has occurred has been limited to non-utility entities. Directed state policies have been a key driver in renewable energy development. Those states not currently addressing renewables may need more data and information before they proceed with directed policies. Other important observations are: The cost of renewables is an overriding concern. Regulators distinguish between 'emerging' and 'established' renewable energy technologies. Specific data are lacking on state-level renewable energy development. Detailed renewable resource assessments have yet to be performed in many states. This report identifies renewable energy information needs of state regulators. However, a number of concerns are also identified that must be addressed before renewables will receive serious attention in many of those states with limited renewables experience. Finally, the report catalogs a wide variety of policies that have been utilized in the states to promote greater development of renewable energy. DOE

N93-23697# Midwest Research Inst., Golden, CO.
NEW 3-5 CELL DESIGN APPROACHES FOR VERY HIGH EFFICIENCY
M. S. Lundstrom, M. R. Melloch, G. B. Lush, G. J. OBradovich, and M. P. Young Jan. 1993 53 p Prepared in cooperation with Purdue Univ., Lafayette, IN
(Contract DE-AC02-83CH-10093)
(DE92-010558; NREL/TP-451-4851) Copyright Avail: CASI HC A04/MF A01

This report describes progress during the first year of a three-year project. The objective of the research is to examine new design approaches for achieving very high conversion efficiencies. The program is divided into two areas. The first centers on exploring new thin-film approaches specifically designed for III-V semiconductors. The second area centers on exploring design approaches for achieving high conversion efficiencies without requiring extremely high quality material. Research activities consisted of an experimental study of minority carrier recombination in n-type, metal-organic chemical vapor deposition (MOCVD)-deposited GaAs, an assessment of the minority carrier lifetimes in n-GaAs grown by molecular beam epitaxy, and developing a high-efficiency cell fabrication process. DOE

N93-23970# Sandia National Labs., Albuquerque, NM.
A REVIEW OF THE EXPERIENCE GAINED IN 10 YEARS OPERATION OF GOULD'S SOLAR INDUSTRIAL PROCESS HEAT SYSTEM
D. C. Knipfer (Gould Electronics, Inc., Chandler, AZ.) and D. Menicucci 1992 7 p Presented at the International American Society of Mechanical Engineers/ASES (ASME/ASES) Joint Solar Energy Conference, Washington, DC, 4-9 Apr. 1993
(Contract DE-AC04-76DP-00789)
(DE93-003991; SAND-92-2481C; CONF-930435-2) Avail: CASI HC A02/MF A01

For nearly 10 years, the Gould Electronics, Incorporated manufacturing plant in Chandler, Arizona, has been a model of how medium-temperature solar thermal energy systems can produce economical industrial process heat (IPH). In 1982, a solar IPH system was designed and built on the site by Solar Kinetics, Inc. The system has remained in operation and continues to provide economical process heat for Gould's copper foil manufacturing operation. System performance and availability has fluctuated over the years, reaching a low point in early 1990 when the system was nearly inoperative because of equipment reliability problems. Gould teamed with engineers from Sandia National Laboratories' (Sandia) Solar Thermal Design Assistance Center to develop a plan to solve the technical problems and refurbish the field. The IPH system is currently operating at over 90-percent equipment availability, returning to Gould a net energy cost savings on the order of $7,500 per month. This paper presents the history and operation of the system from the perspective of the end user and describes the phased upgrade program undertaken with Sandia to refurbish the system. DOE

N93-23983# Army Aeromedical Research Lab., Fort Rucker, AL.
SOLAR-POWERED LIGHT EMITTING DIODE POWER LINE AVOIDANCE MARKER DESIGN Final Report
Ellen H. Snook, Clarence E. Rash, John S. Martin, Richard R. Levine, and Parley P. Johnson Dec. 1992 33 p
(AD-A259886; USAARL-93-6) Avail: CASI HC A03/MF A01

In-flight wire strikes are a constant threat to U.S. Army Aviation during all-weather, daytime and nighttime helicopter operations. Despite routine training on wire avoidance techniques, wire strikes continue to occur, with a majority of the mishaps historically occurring during training and maneuvering over familiar sites. In an effort to increase the conspicuity of suspended cables and wires, the aviation training community at Fort Rucker, Alabama, currently employs a passive wire marking system which consists of international-orange colored spheres suspended from cables and wires in heavily trafficked airspace. During a previous evaluation of wire marker

visibility, a solar-powered wire marker design was developed. This new design incorporates retroreflective material and light emitting diodes (LED's) to provide greater range visibility and detectability during aided and unaided flight. GRA

N93-24013# Hokkaido Development Bureau, Sapporo (Japan).
SURVEY OF THE HOKKAIDO DEVELOPMENT PROJECT
Mar. 1992 301 p
(DE93-761804; ETDE/JP-MF-93761804) Avail: CASI HC A14/MF A03

As a part of the survey of the Hokkaido development project, geothermal resources and mineral resources are investigated in the north area of Tokachi. The temperature of geothermal water is 45-77 C in the bottom of the mines of which the depth is 1000-1300 m. Application fields of geothermal water are space heating, heat source for fishery facilities, bathing, etc. Presently it is used in 10 bathing places, 10 space heating facilities and 11 agricultural and fishery facilities. It is used mostly for public facilities and will be effective for general house hot water supply and preparation of sightseeing places in the future. As measures for effective utilization, hydrothermal systems used in health community plaza, horticultural greenhouse and general house hot water supply are designed, and great effectness in energy saving and economy is indicated. There exist zeolite deposits which produce 7000 tons/year in the Seta area of Kami-Shihoro-cho surveyed. Minable amount of zeolite in the Kami-Shihoro area is estimated at 800,000 m(sup 3). Production of natural zeolite in Japan is 140,000 tons/year, which is used mostly for agricultural soil conditioner and also for industrial drying, adsorptional separation and water treatment. With the expanding utilization field, it is expected to contribute to activation of the regional economy. DOE

N93-24032# Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels.
SOLAR COLLECTOR MANUFACTURING ACTIVITY 1991
Dec. 1992 66 p
(DE93-006559; DOE/EIA-0174(91)) Avail: CASI HC A04/MF A01

The Solar Collector Manufacturing Activity 1991 report prepared by the Energy Information Administration (EIA) presents summary and detailed data provided by US-based manufacturers and importers of solar collectors. Summary data on solar thermal collector shipments are presented for the period 1974 through 1991. Summary data on photovoltaic cell and module shipments are presented for the period 1982 through 1991. Detailed information for solar thermal collectors and photovoltaic cells and modules are presented for 1991. The standard unit of measure for solar thermal collectors is square feet of collector surface and for photovoltaic cells and modules is peak watts. DOE

N93-24036# Sandia National Labs., Albuquerque, NM.
SUPPLY OF GEOTHERMAL POWER FROM HYDROTHERMAL SOURCES: A STUDY OF THE COST OF POWER IN 20 AND 40 YEARS
Susan Petty (Petty, Susan Consulting, Solano Beach, CA.), B. J. Livesay (Livesay Consultants, Inc., Encinitas, CA.), W. P. Long (Carlin Gold Co., Inc., Grass Valley, CA.), and John Geyer (Geyer, John and Associates, Vancouver, WA.) Nov. 1992 118 p
(Contract DE-AC04-76DP-00789)
(DE93-004479; SAND-92-7302) Avail: CASI HC A06/MF A02

This study develops estimates for the amount of hydrothermal geothermal power that could be on line in 20 and 40 years. This study was intended to represent a 'snapshot' in 20 and 40 years of the hydrothermal energy available for electric power production should a market exist for this power. This does not represent the total or maximum amount of hydrothermal power, but is instead an attempt to estimate the rate at which power could be on line constrained by the exploration, development and support infrastructure available to the geothermal industry, but not constrained by the potential market for power. DOE

N93-24139# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany). Inst. fuer Technische Thermodynamik.
FUNDAMENTAL DESIGN AND NUMERICAL SIMULATION OF THE NONSTEADY BEHAVIOR OF A SOLAR-DYNAMIC POWER MODULE FOR SPACE APPLICATIONS Ph.D. Thesis - Stuttgart Univ.
[AUSLEGUNGSGRUNDLAGEN UND NUMERISCHE SIMULATION DES INSTATIONAEREN BETRIEBSVERHALTENS EINES SOLARDYNAMISCHEN ENERGIEVERSORGUNGSMODULS FUER RAUMFAHRTMISSIONEN]
Berthold Oberle Apr. 1992 199 p In GERMAN
(DLR-FB-92-09; ETN-93-93524) Avail: CASI HC A09/MF A03; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The nonsteady thermodynamic behavior of a solar-dynamic power module during the flight in the low Earth orbit is numerically simulated and investigated. For the thermal power process, a real Joule process is considered with a single stage compressor, a single stage turbine, and a partial regeneration. Irreversibilities in the different steps of the thermodynamic process are taken into account. For heat generation, a heatpipe receiver with integrated latent heat storage is simulated. A heatpipe radiator is modeled as the heat rejection system. In order to contribute to the nonsteady thermal boundary conditions, it is necessary to simulate the direct insolation, the albedo, and the thermal radiation of the Earth. Referring to the above mentioned key components, the complete solardynamic energy system is designed, calculated thermodynamically, and optimized with regard to maximum efficiency. Assuming four different and representative constellations of the orbit parameters and the sun vector, the dynamic behavior of the total system is analyzed. Adaptation to different energetic boundary conditions is carried out by regulation of the pressure level. The transient behavior of the solar dynamic energy system is analyzed for some postulated failure conditions. The results show that a well designed receiver storage system has enough inherent protection against overheating even in the event of a sudden failure of the receiver cooling. It is also proved that even a failure of half of the radiator area or a corresponding degradation of the radiator surfaces results in a slight reduced power output in the range of only 10 to 15 percent. ESA

N93-24324# Horizon Data Corp., Reston, VA.
INTERAGENCY ADVANCED POWER GROUP STEERING GROUP MEETING MINUTES
18 Nov. 1992 78 p Presented at the Interagency Advanced Power Group (IAPG) Steering Group Meeting, Ft. Belvoir, VA, 18 Nov. 1992
(Contract DE-AC01-90CE-90053)
(DE93-005641; CONF-9211143-Summ) Avail: CASI HC A05/MF A01

This document contains presentation overviews and viewgraphs from a meeting on the subject of power generation and distribution systems for military applications. Mission analysis and directional plans were given for each working group (chemical, mechanical, electrical, nuclear, solar and systems). Attendees represented the US Air Force, Army, Navy, and NASA. DOE

N93-24432# Midwest Research Inst., Golden, CO.
BASIC STUDIES OF 3-5 HIGH EFFICIENCY CELL COMPONENTS
M. S. Lundstrom, M. R. Melloch, R. F. Pierret, M. S. Carpenter, H. L. Chuang, P. E. Dodd, A. Keshavarzi, M. E. Klausmeier-Brown, G. B. Lush, and T. B. Stellwag Jan. 1993 67 p Prepared in cooperation with Purdue Univ., Lafayette, IN
(Contract DE-AC02-83CH-10093)
(DE92-010563; NREL/TP-451-4850) Avail: CASI HC A04/MF A01

This project's objective is to improve our understanding of the generation, recombination, and transport of carriers within III-V homo- and heterostructures. The research itself consists of fabricating and characterizing solar cell 'building blocks' such as junctions and heterojunctions as well as basic measurements of material parameters. A significant effort is also being directed at characterizing loss mechanisms in high-quality, III-V solar cells fabricated in industrial research laboratories throughout the United States. The project's goal is to use our understanding of the device physics of high-efficiency cell components to maximize cell efficiency. A related goal is the demonstration of new cell structures fabricated by molecular beam epitaxy (MBE). The development of measurement techniques and characterization methodologies is also a project objective. This report describes our progress during the fifth and final year of the project. During the past five years, we've teamed a great deal about heavy doping effects

in p(sup +) and n(sup +) GaAs and have explored their implications for solar cells. We have developed an understanding of the dominant recombination losses in present-day, high-efficiency cells. We've learned to appreciated the importance of recombination at the perimeter of the cell and have developed techniques for chemically passivating such edges. Finally, we've demonstrated that films grown by molecular beam epitaxy are suitable for high-efficiency cell research. DOE

N93-24513# Westinghouse Electric Corp., Pittsburgh, PA. Science and Technology Center.

RECENT PROGRESS IN ZIRCONIA-BASED FUEL CELLS FOR POWER GENERATION

S. C. Singhal 1992 31 p Presented at the 5th International Conference on the Science and Technology of Zirconia, Melbourne, Australia, 16-21 Aug. 1992

(Contract DE-FC21-91MC-28055)

(DE93-003488; DOE/MC-28055/93/C0135; CONF-9208144-3) Avail: CASI HC A03/MF A01

High temperature solid oxide fuel cells based upon yttria-stabilized zirconia electrolyte offer a clean, pollution-free technology to electrochemically generate electricity at high 'efficiencies. This paper reviews the designs, materials, and fabrication processes used for such fuel cells. Most progress to date has been achieved with tubular geometry cells. A large number of tubular cells have been electrically tested, some to times up to 30,000 hours; these cells have shown excellent performance and performance stability. In addition, successiyely larger size electric generators utilizing these cells have been designed, built, and operated since 1984. Two 25 kW power generation field test units have recently been fabricated; these units represent a major milestone in the commercialization of zirconia-based fuel cells for power generation. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N93-22472# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.

NRC TWIN OTTER OPERATIONS IN THE 1991 CALIFORNIA OZONE DEPOSITION EXPERIMENT

J. I. MacPherson May 1992 213 p

(NRC-LTR-FR-118; CTN-93-60702) Avail: CASI HC A10/MF A03

In the summer of 1991, a 4-week international field experiment was conducted to measure ozone concentrations and fluxes in the San Joaquin Valley, California. The field data will be used to improve understanding of the exchange processes occurring between the atmosphere and various types of vegetation. The data will also be used to develop a comprehensive computer model for ozone transport and deposition in the valley. Canadian participation in this experiment comprised a series of low level flights, with repeated passes over agricultural sites (cotton, grapes, grassland, orchards, tomatoes), as well as regional-scale flights and higher-level soundings to document atmospheric conditions. Specific information is given on the aircraft instrumentation, software, recorded parameters, analysis procedures, data formats, flight characteristics, and data collected on fluxes of sensible and latent heat, CO2, momentum, and ozone. The highest ozone deposition velocities were measured over corn and cotton sites. A correlation is suggested between the measured greenness index and the ozone deposition velocity; this relationship is almost independent of the type of vegetation overflown. This in turn suggests a method for characterizing the deposition velocities for the entire valley using remotely sensed data from satellites. CISTI

N93-22597# Finnish Academy of Technology, Helsinki.

THE FINNISH RESEARCH PROGRAMME ON CLIMATE CHANGE Progress Report

Markku Kanninen, ed. and Pia Anttila, ed. 1992 310 p

(DE93-752870; SA-PUB-3/92; ISBN-951-37-0846-1) Avail: CASI HC A14/MF A03

In 1989, the Ministry of Environment set up a committee to anaiyze our current knowledge on climatic changes and to define research needs related to the issue. The committee concluded its work by proposing that a large-scale multidisciplinary national research programme on climate change should be initiated. The committee defined the principal goals of the Finnish Research Programme on Climate Change (SILMU) as being to increase our knowledge on climate change, its causes, mechanisms and consequences; to strengthen the research on climate change in Finland; to increase the participation of Finnish researchers in international research programmes, and to prepare and disseminate information for policy makers on adaptation and mitigation. The key areas where research is to be directed are defined as: quantification of the greenhouse effect and the magnitude of anticipated climatic changes; assessment of the effects of changing climate on ecosystems, and development of mitigation and adaptation strategies. This volume comprises reports of the research projects included in SILMU. The aim of these reports is to describe the progress made in research during 1990-91, to illustrate the problem setting and lay out of the research work, and to present the results obtained. Due to the fact that most of the projects started in June 1990, only preliminary results can be presented at this stage. Future progress in SILMU will be reported periodically, with a final report being produced when the programme ends. DOE

N93-22602# Department of Energy, Davis, CA. National Inst. for Global Environmental Change.

CARBON DIOXIDE, CLIMATE, AND THE DEEP OCEAN CIRCULATION: CARBON CHEMISTRY MODEL

A. S. Menawat (Tulane Univ., New Orleans, LA.) 21 Sep. 1992 13 p

(Contract DE-FC03-90ER-61010)

(DE93-005061; DOE/ER-61010/1) Avail: CASI HC A03/MF A01

The objective of this study was to investigate the role of oceanic carbon chemistry in modulating the atmospheric levels of CO2. It is well known that the oceans are the primary sink of the excess carbon pumped into the atmosphere since the beginning of the industrial period. The suspended particulate and the dissolved organic matters in the deep ocean play important roles as carriers of carbon and other elements critical to the fate of CO2. In addition, the suspended particulate matter provides sites for oxidation-reduction reactions and microbial activities. The problem is of an intricate system with complex chemical, physical, and biological processes. This report describes a methodology to describe the interconversions of different forms of the organic and inorganic nutrients, that may be incorporated in the ocean circulation models. Our approach includes the driving force behind the transfers in addition to balancing the elements. Such thermodynamic considerations of describing the imbalance in the chemical potentials is a new and unique feature of our approach. DOE

N93-22716# Harvard Univ., Cambridge, MA. Law School.

A PROMPT START: IMPLEMENTING THE FRAMEWORK CONVENTION ON CLIMATE CHANGE

A. Chayes, E. B. Skolnikoff (Massachusetts Inst. of Tech., Cambridge.), and D. G. Victor (Massachusetts Inst. of Tech., Cambridge.) 1992 33 p Presented at the Institutional Aspects of International Cooperation on Climate Change, Bellagio, Italy, 28-30 Jan. 1992

(Contract DE-FC03-90ER-61010)

(DE93-005062; DOE/ER-61010/2; CONF-9201121-Summ) Avail: CASI HC A03/MF A01

A Framework Convention on Climate Change is under active negotiation in the United Nations with the expectation it will be ready for Signature at the Rio Conference this June. Under the most optimistic projections, a Convention will not come into force and be an effective instrument for months, probably years. In recognition of the several institutional tasks that will be of crucial importance whatever the detailed content of the Convention a small group of high international organizations involved in the negotiations was convened at the Rockefeller Foundation's Conference Center at Bellagio in January. The discussions at Bellagio on the need for a Prompt Start on these institutional tasks benefitted from earlier meetings at Harvard in March and at Bermuda in May, 1991, that the co-organizers convened to discuss these and related aspects of the negotiations on a Climate Convention. Those meetings were attended by members of the academic community, officials from the United Nations, and representatives of governments involved in the negotiations. DOE

N93-22767# Department of Energy, Washington, DC. Environmental Sciences Div.

ATMOSPHERIC SCIENCES PROGRAM
Nov. 1992 55 p
(DE93-004891; DOE/ER-0568T) Avail: CASI HC A04/MF A01

The mission of the Department's Environmental Processes and Effects Research (EPER) Program, in which the Atmospheric Science Program resides, is as follows: (1) quantify the physical, chemical, geological, and biological processes that transport, disperse, and transform energy-related materials in the atmosphere and in terrestrial and marine co-systems; (2) to determine the mechanisms of degradation and detoxification of hazardous energy related materials in the environment; and (3) to determine and manage the capacity for ecosystem adjustments to energy-related environmental stresses. This publication describes research on atmospheric chemistry. DOE

N93-22803*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ENVIRONMENTAL PROJECTS. VOLUME 14: REMOVAL OF CONTAMINATED SOIL AND DEBRIS
Len Kushner 15 Mar. 1992 126 p
(Contract NAS7-918)
(NASA-CR-192803; NAS 1.26:192803; JPL-Publ-87-4) Avail: CASI HC A07/MF A02

Numerous diverse activities at the Goldstone Deep Space Communications Complex (GDSCC) are carried out in support of six parabolic dish antennas. Some of these activities can result in possible spills or leakages of hazardous materials and wastes stored both above ground in steel drums and below ground in underground storage tanks (UST's). These possible leaks or spills, along with the past practice of burial of solid debris and waste in trenches and pits, could cause local subsurface contamination of the soil. In 1987, the Jet Propulsion Laboratory (JPL), retained Engineering-Science, Inc. (E-S), Pasadena, California, to identify the specific local areas within the GDSCC with subsurface soil contamination. The E-S study determined that some of the soils at the Apollo Site and the Mars Site were contaminated with hydrocarbons, while soil at a nonhazardous waste dumpsite at the Mojave Base site was contaminated with copper. This volume is a JPL-expanded version of the PE209 E-S report, and it also reports that all subsurface contaminated soils at the GDSCC were excavated, removed, and disposed of in an environmentally acceptable way, and the excavations were backfilled and covered in accordance with accepted Federal, State, and local environmental rules and regulations. Author (revised)

N93-22805# Technical Research Centre of Finland, Espoo.
EXHAUST EMISSIONS FROM DIESEL ENGINES [DIESELMOOTTORIEN PAKOKAASUPAASTOT]
Juhani Laurikko 1992 51 p In FINNISH
(DE93-752852; VTT-JULK-761) Avail: CASI HC A04/MF A01

The amount and composition of exhaust emissions from diesel engines at cold-start and before reaching the normal running temperature were determined. Both direct injection and prechamber-type high-speed engines were studied. Experiments were carried out in the temperature range of (+)20 to (-)30 C, applying both constant and cyclic load during a half-an-hour test period. Emission test were also performed with the direct injection engine in accordance with the ECE R-49 regulation by keeping the engine at the running temperature and the ambient temperature lower than normal. All diesel fuels commercially available in Finland and one jet engine fuel, which is also suited for diesel engines, were used in the experiment. The measuring results indicated that the exhaust gas emissions from the direct injection engine change more than those from the precombustion chamber engine when the start-up and running temperatures decline. These differences may be due to differences in combustion chamber types. In the direct injection engine the emissions of carbon monoxide (CO) and unburnt hydrocarbons (HC) were increased by the decline in the start-up temperature, while the start-up temperature had only a minor effect on nitrogen oxide (NO(x)) emissions. There were only insignificant differences between the tested fuel grades. The low ambient temperature also affected the emissions of the warmed-up engine. The CO and HC emissions increased, dependent on the fuel used, 1.2 to 1.5-fold compared to those measured at a normal temperature, while the NO(x) emissions remained practically unchanged. In the direct injection engine, the formation of so-called white smoke was found to be intensive after the cold start-up. DOE

N93-22922# Pechan (E. H.) and Associates, Inc., Durham, NC.
DEVELOPMENT OF SIZE-SPECIFIC DATA FROM PARTICULATE CONTROL TECHNOLOGY RESEARCH REPORTS Final Report, Mar. - Sep. 1992
T. Allen Dean, Michael R. J. Doorn, William R. Barnard, and Robert Coleman Nov. 1992 46 p Sponsored by Environmental Protection Agency
(Contract EPA-68-D9-0168)
(PB93-131456; EPA/600/R-92/214) Avail: CASI HC A03/MF A01

The report gives size-specific, uncontrolled emission factors and control efficiencies developed from many studies of particulate control device performance conducted under the direction of EPA's Air and Energy Engineering Research Laboratory (AEERL) between 1974 and 1981. The particle size ranges of concern are 02.5, 2.5-6, 6-10, and 0-10 micrometers. These data and the sampling and analysis procedures documented in the reports were subjected to a quality assurance review and then compared with source- and control-device-specific information in several data sources maintained by the EPA's Office of Air Quality Planning and Standards (OAQPS). Where no relevant information existed in these data sources, it was determined that the data developed from these studies should be incorporated into them. Each control device study is reviewed individually. For each study, the source, control device, and sampling configuration are described briefly, the quality of the sampling and analysis methods is rated informally, the data are compared with comparable AP-42 data, and conclusions are drawn regarding the need for the data in the OAQPS data sources. Reviews of documents which yielded data not suitable for inclusion in the OAQPS data sources are also included. GRA

N93-22936# Brookhaven National Lab., Upton, NY.
AEROSOL PHASE TRANSFORMATION IN THE ATMOSPHERE
I. N. Tang and H. R. Munkelwitz Sep. 1992 5 p Presented at the 73rd AMS Annual Meeting, Anaheim, CA, 17-22 Jan. 1993
(Contract DE-AC02-76CH-00016)
(DE93-001903; BNL-47713; CONF-930133-4) Avail: CASI HC A01/MF A01

Ambient aerosols are frequently composed of hygroscopic inorganic salts such as chlorides, sulfates, and nitrates in either pure or mixed forms. Such inorganic salt aerosols exhibit the properties of deliquescence and efflorescence in air. The phase transformation from a solid particle to a saline droplet usually occurs spontaneously when atmospheric relative humidity reaches a level specific to the chemical composition of the aerosol particle. Conversely, when relative humidity decreases and becomes low enough, a saline droplet will evaporate and suddenly crystallize, expelling all its water content. Information on the composition and temperature dependence of these properties is required in mathematical models for describing the dynamic and transport behavior of ambient aerosols. Experiments are carried out in the temperature range 5-35 C, using single particles individually suspended in an electrodynamic cell that can be evacuated and back filled with water vapor. The phase transformation of the aerosol particle is monitored by laser light scattering and the relative humidity at the transition point is determined by directly measuring the water vapor pressure in the cell. Results are obtained for particles containing either a single salt or a preselected mixture of NaCl, KCl, NaNO3, Na2SO4) and (NH4)2SO4, which are common constituents of ambient aerosols. A theoretical model on the composition and temperature dependence of the deliquescence properties is developed for single and two-salt aerosol systems. DOE

N93-22972# Oak Ridge National Lab., TN.
GLOBAL WARMING IMPACTS OF CFC ALTERNATIVE TECHNOLOGIES: COMBINING FLUOROCARBON AND CO2 EFFECTS
P. D. Fairchild, S. K. Fischer, and P. J. Hughes 1992 14 p Presented at the International Energy Agency (IEA) Heat Pump Center Workshop, Merligen, Switzerland, 12-13 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-002347; CONF-9210198-1) Avail: CASI HC A03/MF A01

Chlorofluorocarbons (CFCs) are on their way out, due to their role in stratospheric ozone depletion and the related international Montreal Protocol agreement and various national phaseout timetables. As the research, engineering development, and manufacturing investment decisions have ensued to prepare for this transition away from CFCs, the climate change issue has emerged and there has recently been increased attention on

the direct global warming potential (GWP) of the fluorocarbon alternatives as greenhouse gases. However, there has been less focus on the indirect global warming effect arising from end-use energy changes and associated CO2 emissions. A study was undertaken to address these combined global warming effects. The concept of Total Equivalent Warming Impact (TEWI) was developed for combining the direct and indirect effects and was used for evaluating CFC-replacement options available in the required CFC transition time frame. Analyses of industry technology surveys indicate that CFC-user industries have made substantial progress toward near-equal energy efficiency with many HCFC/HFC alternatives. The findings also bring into question the relative importance of the direct effect in many applications and stress energy efficiency when searching for suitable CFC alternatives. For chillers, household refrigerators, and unitary air-conditioning or heat pump equipment, changes in efficiency of only 2-5 percent would have a greater effect on future TEWI than completely eliminating the direct effect. DOE

N93-23035# Brookhaven National Lab., Upton, NY.
THE IMPLICATIONS OF CONCURRENT INCREASES IN TEMPERATURE AND CO2 CONCENTRATION FOR TERRESTRIAL C3 PHOTOSYNTHESIS
S. P. Long, G. Y. Nie, B. G. Drake (Smithsonian Institution, Edgewater, MD.), and G. Hendrey Sep. 1992 7 p Presented at the 9th International Congress on Photosynthesis, Nagoya, Japan, 30 Aug. - 5 Sep. 1992
(Contract DE-AC02-76CH-00016)
(DE93-005590; BNL-47781; CONF-9208155-4) Avail: CASI HC A02/MF A01

This study utilizes a mechanistic model of lea photosynthesis to examine the potential quantitative significance of the interaction of rising atmospheric. Carbon dioxide concentration (C(sub a)) and temperature on leaf photosynthesis. Predictions are compared to experimental measurements in which plants have been grown either in elevated C(sub a) in the field for extended periods or from seed in controlled environments, to examine the interaction of low temperature with elevated C(sub a). Three questions addressed were: To what extent will increase in C(sub a) modify the response of leaf photosynthetic CO2 uptake (A) to temperature; is the decrease in photosynthesis at sub-optimal temperatures predicted for plants grown at elevated C(sub a), realized in practice? Is photoinhibition accentuated in plants grown in the field at elevated C(sub a) for long-periods. DOE

N93-23057*# National Aeronautics and Space Administration, Washington, DC.
THE ATMOSPHERIC EFFECTS OF STRATOSPHERIC AIRCRAFT Report No. 2
Richard S. Stolarski, ed. (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) and Howard L. Wesoky, ed. Mar. 1993 220 p
(NASA-RP-1293; NAS 1.61:1293) Avail: CASI HC A10/MF A03

This document presents a second report from the Atmospheric Effects of Stratospheric Aircraft (AESA) component of NASA's High-Speed Research Program (HSRP). This document presents a second report from the Atmospheric Effects of Stratospheric Aircraft (AESA) component of NASA's High Speed Research Program (HSRP). Market and technology considerations continue to provide an impetus for high-speed civil transport research. A recent United Nations Environment Program scientific assessment has shown that considerable uncertainty still exists about the possible impact of aircraft on the atmosphere. The AESA was designed to develop the body of scientific knowledge necessary for the evaluation of the impact of stratospheric aircraft on the atmosphere. The first Program report presented the basic objectives and plans for AESA. This second report presents the status of the ongoing research as reported by the principal investigators at the second annual AESA Program meeting in May 1992: Laboratory studies are probing the mechanism responsible for many of the heterogeneous reactions that occur on stratospheric particles. Understanding how the atmosphere redistributes aircraft exhaust is critical to our knowing where the perturbed air will go and for how long it will remain in the stratosphere. The assessment of fleet effects is dependent on the ability to develop scenarios which correctly simulate fleet operations. Author (revised)

N93-23105# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE MAVALE PROJECT: EVALUATION OF POTENTIAL POLLUTION SOURCES TO SUPERFICIAL AND SUBTERRANEAN WATER RESOURCES IN THE PARAIBA DO SUL VALLEY, BRAZIL [PROJECTO MAVALE: AVALIACAO DO POTENCIAL DE POLUICAO DOS RECURSOS HIDRICOS EM FUNCAO DO USO DA TERRA E CARACTERISTICAS DO MEIO FISICO NO VALE DO RIO PARAIBA DO SUL, SP, BRASIL]
Tania Maria Sausen Aug. 1991 14 p In PORTUGESE
(INPE-5318-PRE/1715) Avail: CASI HC A03/MF A01

In May 1976, it was promulgated a law about the prevention and control of environment pollution. In this law, there is a chapter about water pollution. By means of this the objective is to characterize and to evaluate the potential sources (domestic and industrial effluents, waste deposits) in the Paraiba do Sul Valley in order to evaluate the quality of the superficial and subterranean water resources. Multispectral images corresponding to LANDSAT TM 3 and 4, in the scale 1:250.000 patch/row 218 e 219.76 and many thematic maps (land use, geologic, geomorphologic) were analyzed considering the drainage network and the pollution sources in the study area. It was possible to conclude that there are more than 30 pollution sources in the Paraiba do Sul Valley, the water pollution is very high and it is necessary to increase the pollution control in this region.
Author (revised)

N93-23265# Minnesota Univ., Minneapolis.
WATER TEMPERATURE CHARACTERISTICS OF LAKES SUBJECTED TO CLIMATE CHANGE
Midhat Hondzo and Heinz G. Stefan Dec. 1992 181 p Sponsored by Environmental Research Lab, Duluth, MN
(Grant EPA-R-816230)
(PB93-135648; EPA/600/R-92/244) Avail: CASI HC A09/MF A02

A deterministic, one dimensional, unsteady lake water temperature model was modified and validated to simulate the seasonal (spring to fall) temperature stratification structure over a wide range of lake morphometries, and trophic and meteorological conditions. Model coefficients related to hypolimnetic eddy diffusivity, light attenuation, wind sheltering, and convective heat transfer were generalized using theoretical and empirical extensions.
GRA

N93-23266# Environmental Protection Agency, Annapolis, MD. Chesapeke Bay Program.
CHESAPEAKE BAY PROGRAM: WETLANDS WORKGROUP Annual Progress Report
Dec. 1991 13 p
(PB93-136893; CBP/APR-92-105) Avail: CASI HC A03/MF A01

The announcement by President Bush of a national 'no net loss' wetlands policy is the result of growing public concern about the rapid loss of these important resources. Wetlands provide essential breeding, spawning, nesting, and wintering habitats for a major portion of the region's fish and wildlife. In addition, wetlands function to purify surface water, moderate flood flows, maintain year round stream and river flows, reduce erosion, and support commercial fishery and recreation industries. In recognition of the importance of wetlands to the environmental quality and economic productivity of the Bay, the Chesapeake Executive Council adopted the Chesapeake Bay Wetlands Policy in December 1988. The policy includes a commitment to adopt an implementation plan. The annual report discusses the Living Resources Subcommittee's Wetlands Workgroup progress on these projects over the last year, and the near term goals for the next year. The progress to date includes work completed for the first phase and beginning to set up the second phase of the implementation plan.
GRA

N93-23267# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.
ATMOSPHERIC CHEMISTRY AND PHYSICAL FATE OF HCFCs AND HFCs AND THEIR DEGRADATION PRODUCTS Interim Report, Sep. 1990 - Sep. 1992
E. O. Edney Dec. 1992 38 p
(PB93-131449; EPA/600/R-92/222) Avail: CASI HC A03/MF A01

Laboratory experiments were conducted to determine the fate of the proposed CFC substitutes HCFC-22, HCFC-123, HCFC-124, HCFC-141b,

HCFC-142b, HFC-125, HFC-134a, and HFC-152a. The program consisted of the following: photochemical oxidation experiments to identify stable oxidation products and measure their yields; deposition studies to measure the extent oxidation products are absorbed into aqueous media; and experiments to determine the fate of hydrolysis products during droplet evaporation. Model results, obtained using laboratory derived lower limit estimates for aqueous deposition velocities and assuming a well mixed atmosphere, suggest the uptakes rates to cloudwater and oceans are sufficiently fast such that significant buildup of gas phase products is unlikely. The laboratory studies suggest that product accumulation in aqueous media could be affected by losses during evaporation. Direct loss by evaporation of halogenated acids and/or production of volatile compounds after further reactions of the dissolved acids could return halogenated compounds to the atmosphere. GRA

N93-23276# Global Geochemistry Corp., Canoga Park, CA.
ANALYSIS OF ACID PRECIPITATION SAMPLES COLLECTED BY STATE AGENCIES Annual Report, Jan. - Dec. 1990
Lloyd S. Shepard Feb. 1992 254 p Sponsored by EPA, Research Triangle Park, NC
(Contract EPA-68-02-4454)
(PB93-144152; EPA/600/R-93/006) Avail: CASI HC A12/MF A03

The report presents analytical data from the 30 acid precipitation collection sites in the State-Operated Network. Samples are collected weekly in plastic bag liners and shipped in 500 mL polyethylene bottles to Global Geochemistry Corporation (the central laboratory for the network). This report contains maps showing the location of each site, plots of analytical data tables of all field and analytical data, plots comparing field and laboratory pH and conductivity, and information on data quality. Samples are analyzed for pH strong add, conductivity, fluoride, chloride, nitrite phosphate, bromide, nitrate, sulfate, ammonium, sodium, potassium, calcium, and magnesium. The central laboratory renders technical assistance to the collection sites on problems concerning pH and conductivity. Each of the 10 participating state agencies receives analytical reports for the samples analyzed the previous month. Analyte concentration data are put on tape for later inclusion in the Acid Deposition System (ADS) Data Base. GRA

N93-23277# Environmental Protection Agency, Washington, DC. Technology Innovation Office.
INNOVATIVE TREATMENT TECHNOLOGIES Semiannual Status Report No. 4
Linda Fiedler Oct. 1992 87 p
(PB93-133387; EPA/542/R-92/011) Avail: CASI HC A05/MF A01

The twice yearly report contains site-specific information on Superfund sites (both remedial and emergency response actions) and non-Superfund sites (within the Departments of Defense and Energy) where innovative treatment technologies have been or are being used. Innovative treatment technologies are treatment technologies for which a lack of data on cost and performance makes their selection and use at Superfund sites more difficult. The report documents the use of the following innovative treatment technologies to treat ground water in situ, soils, sediments, sludge, and solid-matrix wastes; bioremediation (ex situ), bioremediation (in situ), chemical treatment, dechlorination, in situ flushing, in situ vitrification, soil vapor extraction, soil washing, solvent extraction, thermal desorption, and other technologies. GRA

N93-23301# California Univ., Los Angeles. Lab. of Biomedical and Environmental Sciences.
CO2 EXCHANGE, ENVIRONMENTAL PRODUCTIVITY INDICES, AND PRODUCTIVITY OF OPUNTIA FICUS-INDICA UNDER CURRENT AND ELEVATED CO2 CONCENTRATIONS
P. S. Nobel 1992 28 p
(Contract DE-FG03-91ER-61252)
(DE93-006091; DOE/ER-61252/T1) Avail: CASI HC A03/MF A01

This project involved placing mature cladodes (flattened stem segments) of Opuntia ficus-indica in growth chambers containing 360 or 720 ppM CO2. After nine weeks, the new daughter cladodes initiated on the planted cladodes averaged 7 percent higher in biomass but 8 percent less is area, leading to a specific stem mass for this Crassulacean acid metabolism (CAM) species that was 16 percent higher under the elevated CO2 condition. This is less dramatic than the increase in specific leaf mass for C3 and C4 plants under elevated CO2, which generally ranges from 28 to 40 percent. Another contrast with C3 and C4 Plants was the reliance of the new organs of the CAM plant on biomass translocated from existing organs instead of derived directly from current photosynthate. In this regard, 18 percent less dry weight was translocated from basal cladodes into daughter cladodes of Q. ficus-indica at 720 ppM CO2 compared with 360 ppM. DOE

N93-23306# Oak Ridge National Lab., TN.
CARBON AND BIOGEOCHEMISTRY
W. M. Post and C. B. Field (Carnegie Institution of Washington, Stanford, CA.) 1992 5 p Presented at the International Satellite and Land Surface Characterization Program Americas, Columbia, MO, 23-24 Jun. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001368; CONF-9206303-1) Avail: CASI HC A01/MF A01

The central issue in global biogeochemistry is understanding the processes that result in flow, storage, and transformation of carbon in the atmosphere, terrestrial vegetation and soil, and oceans. To understand the terrestrial biogeochemistry of carbon it is also necessary to know the dynamics of N in particular, and also P and S. N and S also have important trace gas components in their biogeochemical cycles. In all these activities, remote sensing can play several valuable roles. In order to identify these roles and provide information that can lead to future remote sensing developments that can aid investigations into global biogeochemistry, we need to identify important phenomena, define measures and concepts needed to model and understand them, and clarify the role that remote sensing can play. DOE

N93-23348# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.
SURVEY OF DATA FROM THE CONTINUOUS SITES OF THE 1990 ATLANTA OZONE PRECURSOR STUDY
Jack H. Shreffler Nov. 1992 61 p
(PB93-124618; EPA/600/R-92/202) Avail: CASI HC A04/MF A01

The report presents a survey of an air quality data base that was collected in Atlanta, Georgia during July and August 1990. In that period, data were collected continuously at six sites and were recorded as 1-hour averages. Data include concentrations of nitrogen oxides, carbon monoxide, ozone, total non-methane hydrocarbon, and 47 identified species of hydrocarbon. Supporting meteorological data were also recorded. The report contains extensive graphical representations of the data including: (1) mean diurnal curves for all gaseous pollutants; and (2) plots of pollutant characteristics by wind direction. The automated gas chromatography (GC) systems used in the field in Atlanta produced erroneously high isopentane readings at five of the six sites; the problem appeared frequently and in a severe form at two of the sites. GRA

N93-23425# Helsinki Univ. of Technology, Espoo (Finland). Hydrology and Water Resources Management Lab.
COMPUTATIONAL MODELING OF THE ENVIRONMENT WITH APPLICATIONS TO LAKE EUTROPHICATION Ph.D. Thesis
Olli Varis 1991 44 p Sponsored by Suomen Akatemia; Stalaojituksen Tukisaeaetioe r.y.; and Maj and Tor Nessling Foundation
(TKK-1991/1; TKK-Diss-789; ISBN-951-22-0832-6; ETN-93-93691) Avail: CASI HC A03/MF A01

Three shallow Finnish lakes were studied, using computational approaches from three families of techniques. Multivariate techniques were used to investigate the phytoplankton communities and their relation to environmental variables. The analyses were diagnostic, in all but one case, in which the approach was extended to include prediction of the community structure. The lumped parameter approach was used to construct a model for competitive ability of cyanobacteria in one of the lakes. A set of predictive simulations, including changing nutrient input and outflow regulation was performed. Bayesian decision was applied to the analysis of restoration of one of the lakes. The analytic hierarchy process of decision analysis was also reviewed. The substudies showed the need to accept and the ability to utilize a variety of principally different approaches in environmental analysis, and the need to accept different paradigms of scientific problem solving. Equally, the approaches used proved to be applicable in environmental research, planning, and management. ESA

N93-23427# National Academy of Sciences - National Research Council, Washington, DC. Water Science and Technology Board.
GLOBAL CLIMATE CHANGE RESPONSE PROGRAM: A MID-COURSE EVALUATION
Feb. 1992 33 p Sponsored by Department of the Interior
(Contract DI-14-01-0001-90-C-17)
(PB93-146355) Avail: CASI HC A03/MF A01

The successful study partnership of the U.S. Bureau of Reclamation and U.S. Geological Survey on the impacts of climate change in western river basins is addressed. The report considered the scope of the program, the nature of the research projects underway, and the program's future given the real and expected budget cuts. The committee recommends that the bureau develop a sound research program and consider wider issues of population changes and increased water demands along with possible climate change scenarios. GRA

N93-23438# National Ocean Service, Rockville, MD. Strategic Assessment Branch.
SUSCEPTIBILITY OF EAST COAST ESTUARIES TO NUTRIENT DISCHARGES: PASSAMAQUODDY BAY TO CHESAPEAKE BAY
H. Quinn, J. P. Tolson, C. J. Klein, S. P. Orlando, and C. Alexander Jun. 1989 44 p Sponsored by EPA Prepared in cooperation with Delaware Univ., Newark
(PB93-136927) Avail: CASI HC A03/MF A01

This is the third report in a series being developed to assist the U.S. EPA implement its Near Coastal Waters and National Estuary Programs. It summarizes estimates of the relative susceptibility and status of 17 estuaries on the East Coast from Maine through Virginia, with respect to nutrient-related pollution. The information is intended to increase understanding of coastal environmental problems and to serve as a screening tool for coastal resource decision-making. A one-page summary is included in the report for each of the 17 estuaries in the East Coast region from Passamaquoddy Bay through Chesapeake Bay. Each summary contains data on significant physical and hydrologic features, estimations of nutrient loading, pollution susceptibility, and nutrient concentrations, along with a narrative to assist the reader in interpreting the data. GRA

N93-23439# Corvallis Environmental Research Lab., OR.
ARCTIC CONTAMINANTS RESEARCH PROGRAM: RESEARCH PLAN
D. H. Landers (Environmental Protection Agency, Corvallis, OR.), J. Ford (Oregon State Univ., Corvallis.), C. P. Gubula (ManTech Environmental Technology, Inc., Corvallis, OR.), S Allen (Oregon State Univ., Corvallis.), L. Curtis (Oregon State Univ., Corvallis.), N. S. Urquhart (Oregon State Univ., Corvallis.), and J. M. Omernik (Environmental Protection Agency, Corvallis, OR.) Dec. 1992 164 p Sponsored by Oregon State Univ., Corvallis, OR Prepared in cooperation with ManTech Environmental Technology International, Inc., Corvallis, OR
(PB93-135630; EPA/600/R-92/210) Avail: CASI HC A08/MF A02

The research plan was initially intended to contain the information needed to evaluate the U.S. Environmental Protection Agency (EPA) Arctic Contaminant Research Program (ACRP). The scientific aspects of the proposed research form the main body of the document and focus on objectives of the specific research components, current literature, approach, and rationale. The ACRP has three major components: (1) extensive sampling of lichens, mosses, and soils to provide a spatial understanding of the status and extent of contaminants present in arctic ecosystems; (2) lake sediment research to evaluate the source and history of arctic contaminant inputs; and (3) food web research to evaluate the possible effects of atmospherically transported pollutants on arctic food webs. The research plan will be used to provide a framework for the ACRP, based on the preliminary studies done to date and will be implemented over the next five years. The program will undergo additional peer reviews at two-year intervals in the future. GRA

N93-23440# Council on Environmental Quality, Washington, DC.
ENVIRONMENTAL QUALITY Annual Report No. 23
Jan. 1993 469 p
(PB93-139814; ISBN-0-16-041612-4) Avail: CASI HC A20/MF A04; SOD HC

The report is from the Council on Environmental Quality's report for the year 1992 in accordance with section 201 of the National Environmental Policy Act 1969 (42 U.S.C. 4341). Part one includes Environmental issues and policies for the United States on pollution in Agriculture, Coasts and Oceans, public and private lands, and pollution prevention methods. Part two includes environmental issues and trends which provide 100 tables and figures for general environmental problems. GRA

N93-23441# National Academy of Sciences - National Research Council, Washington, DC. Water Science and Technology Board.
REVIEW OF EPA'S ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM (EMAP)
Jun. 1992 36 p Sponsored by EPA
(Contract EPA-68-C0-0082/C)
(PB93-146348) Avail: CASI HC A03/MF A01

Review of EPA's Environmental Monitoring and Assessment Program (EMPA) is an interim report on the committee's review of EPA's Environmental Monitoring and Assessment Program (EMAP). The committee endorses EPA's recognition that long-term ecological monitoring and research are essential and that EPA's statutory responsibilities are not limited to human health. The report concluded that probability-based sampling on a grid is an appropriate method of delineating the extent and providing a periodically updated survey of the nation's ecological resources. The committee also addresses questions concerning the ability of EMAP to achieve its other major goals, i.e., the assessment of status, the detection and characterization of changes or trends in the status of the ecological resources of the country, and the establishment of association between ecological condition and human-induced stresses. Because of the many concerns and substantive questions about the design and implementation of EMAP, the committee recommends that the program not be fully implemented until further evaluations are completed. GRA

N93-23450# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Materials Studies.
MEASURING VARIATION IN ECOSYSTEM SENSITIVITY TO STRESS Annual Technical Report, Sep. 1991 - Oct. 1992
John Cairns, Jr., Paul V. McCormick, and Eric P. Smith 28 Oct. 1992 35 p
(Grant AF-AFOSR-0379-91)
(AD-A259521; AFOSR-92-1003TR) Avail: CASI HC A03/MF A01

The objectives of this study were to develop a method for measuring biological responses to stress in situ and to use this method to evaluate the extent to which stream ecosystems vary their sensitivity to anthropogenic stress. Chemical-diffusing substrates were constructed from tissue culture flasks and ceramic tiles, which provided a surface that was suitable for the growth of stream microorganisms and porous to most chemicals. Static laboratory tests showed that many common classes of chemicals diffused through these substrates in a highly predictable manner. A laboratory stream study provided further evidence for repeatable diffusion rates and allowed for the standardization of a sampling protocol for characterizing microbial community responses to stress. Two field studies were conducted using the diffusers to evaluate interecosystem variation in stream microbial responses to experimental gradients of sulfuric acid and chlorine. Data analyses from these experiments are ongoing, but indicate that predictable responses to such gradients can be obtained in situ and analyzed using conventional statistical techniques. The protocol developed has broad applications for both basic and applied research in environmental science. GRA

N93-23651# National Center for Atmospheric Research, Boulder, CO. Environmetal and Social Impacts Group.
METHODS FOR ANALYZING EXTREME EVENTS UNDER CLIMATE CHANGE Final Report
Richard W. Katz and Barbara G. Brown Jan. 1993 41 p
(Contract EPA-CR-815732-03-0)
(PB93-146827; EPA/600/R-93/014) Avail: CASI HC A03/MF A01

The report summarizes work completed through a cooperative agreement between the National Center for Atmospheric Research (NCAR) and the Environmental Protection Agency (EPA) to study methods for analyzing extreme climate events. The overall goal of this project is to develop statistical models for extreme climate events that will be useful for the construction and application of scenarios of future climate. The results of this study will provide methods for determining how the likelihood of extreme climate events may change as other more general climate parameters (e.g., the mean or variance) change. GRA

N93-23681# Environmental Protection Agency, Washington, DC. Engineering and Analysis Div.
PROCEEDINGS OF THE 15TH ANNUAL EPA CONFERENCE ON ANALYSIS OF POLLUTANTS IN THE ENVIRONMENT
Dec. 1992 736 p Conference held in Norfolk, VA, 6-7 May 1992
(PB93-152601; EPA/821/R-92/007) Avail: CASI HC A99/MF A06

The document contains the information presented at the Fifteenth Annual EPA Conference on Analysis of Pollutants in the Environment. It includes papers presented as well as graphs and charts shown. GRA

N93-23861# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
A SNOW COVER MODEL FOR GLOBAL CLIMATIC SIMULATIONS
Bettina Loth, Hans F. Graf, and Josef M. Oberhuber (Hamburg Univ., Germany.) Jun. 1992 52 p
(MPIM-85; ETN-93-93679) Avail: CASI HC A04/MF A01

A layered one dimensional model of a snow cover, which combines a relatively accurate model physics and a short computer time, is presented. The model simulates the important internal processes of temperature and water vapor diffusion, melting, and freezing, extinction of short wave radiation, and liquid water retention. It is based on the mass and energy balances and can be utilized for both temporal and permanent snow covers. In order to keep the possibility of using the model on a global scale, no local parameterizations are employed. An efficient numerical scheme makes the model suitable for long term climatic studies. Integrations for Potsdam (East Germany), 52 deg north, 13 deg east, with standard synoptic measurements over a period of six winters demonstrate a very good correspondence between the observed and computed values. The remaining problem is the choice of a satisfactory criterion for the distinction between snow and rain which strongly influences the situation results of snow depth and water equivalent. ESA

N93-23874# Corvallis Environmental Research Lab., OR.
EFFECTS OF UV-B AND GLOBAL CLIMATE CHANGE ON RICE Annual Progress Report
David Olszyk, Dominique Bachelet (ManTech Environmental Technology, Inc., Corvallis, OR.), Steven Holman (ManTech Environmental Technology, Inc., Corvallis, OR.), Kenneth Fischer (International Rice Research Inst., Manila, Philippines.), K. L. Heong (International Rice Research Inst., Manila, Philippines.), Keith Ingram (International Rice Research Inst., Manila, Philippines.), Heinz-Ulrich Neue (International Rice Research Inst., Manila, Philippines.), Martin Kropff (International Rice Research Inst., Manila, Philippines.), Paul Teng (International Rice Research Inst., Manila, Philippines.), and Ben Vergara (International Rice Research Inst., Manila, Philippines.) Dec. 1992 95 p
(Contracts EPA-68-C8-0006; EPA-CR-817426)
(PB93-135622; EPA/600/R-92/241) Avail: CASI HC A05/MF A01

The document describes the first year of research by the Rice Research Program conducted cooperatively at the Environmental Research Laboratory in Corvallis (ERL-C), Oregon, USA; and the International Rice Research Institute (IRRI) at Los Banos, the Philippines. It covers the period of 1 October, 1990 through 30 September, 1991. The first year of the program saw significant accomplishments in setting up the administrative framework for the program, refining the research objectives, and initiating the research. However, this was only the beginning. The next four years of the project will include intensive modeling and research activities to assess the effects of UV-B radiation and global climate change on rice productivity. GRA

N93-23989# Air Force Engineering and Services Center, Tyndall AFB, FL. Engineering and Services Lab.
CHLOROTRIFLUOROETHYLENE DECAY IN THE ATMOSPHERE: CONTROLLED-ENVIRONMENT CHAMBER STUDIES Interim Report, Oct. 1990 - Nov. 1991
Daniel A. Stone and James R. Long May 1992 70 p
(AD-A259902; AFESC/ESL-TR-91-48) Avail: CASI HC A04/MF A01

A series of experiments conducted to shed additional light on the role of surface-catalyzed reactions on the potential atmospheric oxidation of chlorotrifluoroethylene (CTFE) vapor is discussed. The experiments were conducted in a controlled-environment chamber consisting of a one-meter diameter stainless steel sphere which is Teflon coated. Vapor-phase CTFE was introduced into the chamber at the 5-10 ppm concentration level. It was exposed to helium, then helium with 20 percent oxygen, then helium with 20-50 ppm ozone added, and to humid (approx. 75 percent R.H.) helium, both with and without oxygen. After these initial experiments were concluded, 20 corroded aluminum plates were added to the chamber which increased its surface area by about a factor of ten. Then CTFE was introduced with dry helium, helium plus oxygen, and helium plus ozone. GRA

N93-24011# California Univ., Berkeley.
A MICROCLIMATE MODEL TO INVESTIGATE GREENHOUSE WARMING OF A SUB-ALPINE ECOSYSTEM Ph.D. Thesis
K. P. Shen 1992 85 p
(Contract DE-AC05-76OR-00033)
(DE93-005290; DOE/OR-00033/T507) Avail: CASI HC A05/MF A01

Increasing concentrations of greenhouse gases in the earth's atmosphere are expected to result in a global warming of several degrees Celsius in the coming decades. This warming will have far-reaching impacts on the biosphere, and while General Circulation Models (GCMs) try to predict the magnitude and scope of the warming, there is little information regarding the potential impacts of greenhouse warming on natural systems. An experiment currently under way in a meadow in the Colorado Rocky Mountains attempts to investigate the many consequences of greenhouse warming for soil ecosystems. A mathematical model of the soil microclimate was developed to simulate the soil temperature and moisture content of the meadow. The model simulates both treatment and control scenarios so as to investigate the potential effects of warming. Results of model simulation studies indicate warmer, drier soils under treatment conditions, with the greatest temperature effects of warming occurring at night. These results could have several implications regarding the dynamics of the ecosystem, and future model studies will investigate these connections. DOE

N93-24015# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.
GENERAL CIRCULATION MODEL OUTPUT FOR FOREST CLIMATE CHANGE RESEARCH AND APPLICATIONS
Ellen J. Cooter, Brian K. Eder, Sharon K. LeDuc, and Lawrence Truppi Nov. 1992 63 p
(PB93-124626; EPA/600/R-92/217) Avail: CASI HC A04/MF A01

General Circulation Models (GCM's) have projected global warming of from 3 to 8 degrees F to take place over a period of from 50 to 100 years. The Forest Service Southern Global Change Program (SGCP) has proposed the use of GCM output as input to forest assessment models to estimate the potential impacts of climate changes on forests of the South and Southeastern U.S. The report reviews, organizes, summarizes and makes recommendations concerning the use of four climate model projections in forest assessments. Some primary sources of inter-model variability include model version (age), numerical solution technique, time and space resolution, and parameterization schemes. Model version generally impacts the time and space resolution and choice of parameterization schemes. Magnitude of change varies widely, but the four GCM's examined here all project warmer air temperatures and higher humidities throughout the year, decreasing cloud cover during the Fall, Winter, and Spring seasons and increasing summertime precipitation for the South and Southeastern U.S. Although some consensus among models over large geographic regions can be identified, there is as yet, no established means of determining the confidence that can be placed in these outlooks. GCM output should be combined with historical case studies and empirical and semi-empirically constructed climate scenarios to provide a range of possible climatological futures. Author

N93-24046# Japan Society for Safety Engineering, Tokyo.
THE 111TH MEETING FOR RESEARCH OF SAFETY ENGINEERING
27 Jul. 1992 8 p In JAPANESE Meeting held 27 Jul. 1992
(DE93-753679; ETDE/JP-mf-93753679) Avail: CASI HC A02/MF A01

The 111th meeting for research of safety engineering was held on 27th July, 1992. The topic presented by Igawa of Kanagawa university has been movement and effect of acid materials in the environmental atmosphere. Further, Hyomi of Japan environmental health center has made presentation on the present condition of environmental pollution in Japan and East Asian countries, mainly emphasizing atmospheric pollution. According to former presentation, the main acid materials contained in the pollutants released in the atmosphere are sulfur oxides and nitrogen oxides. The fallout of acid materials are represented by acid rain and acid fog,

and they have environmental effects such as: direct effect to human body, destruction of forest, acidification of lakes and marshes, and pollution of outdoor sculptures and construction materials. It is cited that the termination of the source for pollution is necessary to solve the pollution problems. As for the later topic, the presentation is made on the results of direct investigation of atmospheric pollution problems faced by Taiwan, Thailand and China since 1980's. DOE

N93-24089 Institut d'Aeronomie Spatiale de Belgique, Brussels.
THE CLIMATE INDUCED VARIATION OF THE CONTINENTAL BIOSPHERE: A MODEL SIMULATION OF THE LAST GLACIAL MAXIMUM
P. Friedlingstein (Vrije Univ., Brussels, Belgium.), C. Delire (Liege Univ., Belgium.), J. F. Mueller, and J. C. Gerard (Liege Univ., Belgium.) 1992 20 p Submitted for publication
(Aeronautica-Acta-A-366; ETN-93-93538) Avail: Inst. d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

A simplified three dimensional global climate model was used to simulate the surface temperature and precipitation distributions for the Last Glacial Maximum (LGM), 18,000 years ago. These fields were applied to a bioclimatic scheme which parameterizes the distribution of eight vegetation types as a function of biotemperature and annual precipitation. The model predicts a decrease, for LGM compared to present, in forested area balanced by an increase in desert and tundra extent, in agreement with a reconstruction of the distribution of vegetation based on paleodata. However, the estimated biospheric carbon content (phytomass and soil carbon) at LGM is less reduced than in the reconstructed one. Possible reasons for this discrepancy are discussed. ESA

N93-24163# TRC Environmental Consultants, Inc., Chapel Hill, NC.
GUIDELINES FOR ESTIMATING AND APPLYING RULE EFFECTIVENESS FOR OZONE CO STATE IMPLEMENTATION PLAN BASE YEAR INVENTORIES
Nov. 1992 84 p Sponsored by Environmental Protection Agency, Research Triangle Park, NC
(Contract EPA-68D00121)
(PB93-131498; EPA/452/R-92/010) Avail: CASI HC A05/MF A01

The guidelines describe the procedures developed by the Office of Air quality Planning and Standards (OAQPS) to estimate the effectiveness of existing regulatory programs to achieve emissions control for stationary sources. One approach is the detailed study protocol developed by the Environmental Protection Agency (EPA) Stationary Source Compliance Division (SSCD) involving on-site inspection and testing on a single source category by source category basis. The second approach, developed by the Air Quality Management Division (AQMD), involves answering generic questionnaires using available file information for specific sources and extrapolating the results to other sources in the same source categories. The third option is to use the 80 percent default for estimating RE. The results of these approaches are to be used to estimate RE for the base year emission inventories being prepared in response to the 1990 CAAA calls for ozone and CO SIP's. GRA

N93-24165# Air Force Civil Engineering Center, Tyndall AFB, FL.
HYDRAZINE DECAY IN THE ATMOSPHERE: CONTROLLED-ENVIRONMENT CHAMBER STUDIES AND KINETIC MODELING Final Report, Oct. 1987 - Sep. 1990
Daniel A. Stone and James R. Long Feb. 1992 229 p
(AD-A260252; AFCESA/ESL-TR-91-34) Avail: CASI HC A11/MF A03

A series of experiments conducted to shed additional light on the role of surface-catalyzed reactions on the atmospheric oxidation of hydrazine vapor are documented. The experiments were conducted in a controlled-environment chamber consisting of a one-meter diameter stainless steel sphere which is Teflon coated. Vapor-phase hydrazine was introduced into the chamber at the 50-100 ppm concentration level. It was combined with four different synthetic atmospheric mixtures (all at one atmosphere total pressure): dry helium, humid (approx. 75 percent R.H.) helium, 80 percent dry helium plus 20 percent oxygen, and 80 percent humid helium plus 20 percent oxygen. A series of experiments were conducted, using the same four synthetic atmospheres listed above, with several types of plates which were placed into a rack in the chamber. These plates included: Teflon-coated aluminum (TCA), black iron (BI), corroded aluminum (CA), and F-16 painted aluminum (PA). The reactivity of the plates towards hydrazine decay was: TAC is less than BI approximatley equal to PA is less than CA. GRA

N93-24226# National Oceanic and Atmospheric Administration, Boulder, CO. Climate Monitoring and Diagnostic Lab.
NOAA/CMDL ATMOSPHERIC METHANE DATA FROM SHIPBOARD FLASK SAMPLING Technical Report, 1983 - 1990
P. M. Lang, L. P. Steele, L. S. Waterman, R. C. Martin, and K. A. Masarie Nov. 1992 94 p Sponsored by Cooperative Inst. for Research in Environmental Science, Boulder, CO
(PB93-136489; NOAA-TM-ERL-CMDL-4) Avail: CASI HC A05/MF A01

The memorandum presents atmospheric methane data obtained through the shipboard sampling component of the NOAA/CMDL global cooperative flask sampling program. A significant part of the program has involved flask sampling from a commercial container ship, the Southland Star, on regular crossings of the Pacific Ocean between the U.S. west coast and New Zealand. Shipboard flask sampling has also been carried out on a variety of oceanographic research expeditions. Tabulations are provided for individual flask measurements and annual mean methane mixing ratios for 14 sites spaced every five degrees of latitude across the Pacific Ocean between 30 deg N and 35 deg S. The methane data from the Southland Star are also shown as time series plots. The locations of flask sampling on the oceanographic research expeditions are shown in a series of maps. The flask methane data from these expeditions are shown as a series of plots of methane versus latitude. A brief history of the development of the sampling program is included. Flask sampling methods, and analytical and calibration procedures are documented. GRA

N93-24334# National Geophysical Data Center, Boulder, CO.
GLOBAL ECOSYSTEMS DATABASE. VERSION 1.0 (ON CD-ROM). EPA GLOBAL CLIMATE RESEARCH PROGRAM. NOAA/NGDC GLOBAL CHANGE DATABASE PROGRAM. USER'S GUIDE. VOLUME 1. NGDC KEY TO GEOPHYSICAL RECORDS DOCUMENTATION NO. 26
J. J. Kineman Jun. 1992 138 p Sponsored by Corvallis Enviornmental Research Lab., OR
(PB93-146082; EPA/600/R-92-194A) Avail: CASI HC A07/MF A02

The user's guide gives a complete description of the overall project, including management, research, development, and review procedures that support the integration and improvement of this database, details of the database structure, organization of the CD-ROM, information on use with geographic information systems, and as information on links between the database and global change characterization and modeling. GRA

N93-24515# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
DIRECT CATALYTIC DECOMPOSITION OF NITRIC OXIDE
M. Flytzani-Stephanopoulos, A. F. Sarofim, and Y. Zhang 1992 13 p
(Contract DE-FG22-91PC-91293)
(DE93-008107; DOE/PC-91293/T1) Avail: CASI HC A03/MF A01

This project investigates a suitable catalyst system for direct NO decomposition in post-combustion NO(x) control. Since the process does not use a reductant, it is a greatly simplified process basically involving passing the flue gas through a catalytic converter. Catalysts are prepared by incorporating metal cations into zeolite supports by ion exchange. Catalysts of primary interest include Cu, Pd, Ag, and Ni exchanged zeolites. Particular emphasis is given on promoted Cu-exchanged zeolites, especially the catalyst system Mg/Cu-ZSM-5 and a few others, which are promising for NO conversion to nitrogen at typical flue gas O2 and NO levels and over the temperature range of 723-873 K. Effects of zeolite modification, Cu exchange level and catalyst preparation conditions on the catalyst activity are studied in a packed-bed microreactor. Temperature-programmed desorption and reduction experiments will be carried out in a thermogravimetric analyzer and a single-particle electrodynamic balance. Kinetic studies of NO and O2 interaction with catalysts over a wide temperature range as well as catalyst structural investigations are planned. DOE

N93-24521# California Univ., Davis. Dept. of Agronomy and Range Science.
ANALYSIS AND SYNTHESIS OF MODELS FOR EFFECTS OF CLIMATE CHANGE ON AGRICULTURAL SYSTEMS

S. Geng, R. Plant, and R. Loomis 27 Jul. 1992 9 p
(Contract DE-FC03-90ER-61010)
(DE93-007949; DOE/ER-61010/T5) Avail: CASI HC A02/MF A01

Our objectives are to develop a new integrative physiological-morphological model of the wheat crop that will behave realistically in high-CO2 environments, and to update the ALFALFA model to match the wheat model's photosynthetic structures and microclimates. DOE

N93-24567# National Oceanic and Atmospheric Administration, Boulder, CO. Climate Monitoring and Diagnostics Lab.
AEROSOL MEASUREMENTS AT THE SOUTH POLE DURING 1987
Barry A. Bodhaine and Joyce M. Harris Nov. 1992 122 p
(PB93-137016; NOAA-DR-ERL-CMDL-9) Avail: CASI HC A06/MF A02

The Climate Monitoring and Diagnostics Laboratory (CMDL) of the National Oceanic and Atmospheric Administration (NOAA) operates an atmospheric monitoring observatory at Amundsen-Scott Station, South Pole. The aerosol measurement program consists of the continuous measurement of condensation nuclei (CN) concentration and aerosol scattering extinction coefficient. During 1987, a special aerosol experiment was conducted that included filter samples for subsequent analysis by the proton induced x-ray emission technique, diffusion battery measurements for size information in the sub-0.1 micrometer size range, and aerosol absorption measurements using an aethalometer. Surface and upper air meteorological data were also available. The purpose of the report is to present all of the aerosol data obtained during 1987. GRA

N93-24584# Environmental Protection Agency, Research Triangle Park, NC. Office of Air Quality Planning and Standards.
ENABLING DOCUMENT FOR REGULATIONS GOVERNING COMPLIANCE EXTENSIONS FOR EARLY REDUCTIONS OF HAZARDOUS AIR POLLUTANTS
Dec. 1992 137 p
(PB93-147007; EPA/450/3-91/013) Avail: CASI HC A07/MF A02

The regulations governing compliance extensions for early reductions of hazardous air pollutants are promulgated under the authority of section (612)(i)(5) of the Clean Air Act (CAA). These rules would apply to sources that seek compliance extensions from standards promulgated under section (112)(d) of the CAA. Practical information on the implementation of the Early Reductions Program is provided. Author

N93-24636# Kentucky Water Resources Research Inst., Lexington.
USE OF HIGH-ENERGY RADIATION FOR DEGRADATION OF ENVIRONMENTAL POLLUTANTS
R. D. Guthrie and M. Patwardhan Oct. 1992 54 p Sponsored by Geological Survey, Reston, VA, and NIH
(Contract DI-14-08-0001-G2021; NIH-BRSG-S07-RR07114-21)
(PB93-149995; RR-183; USGS/G-2021-04) Avail: CASI HC A04/MF A01

The purpose of the project was to explore the advantages and/or limitations of high-energy radiation treatment as a method for degrading organic pollutants, particularly aryl halides, in an aqueous medium. The authors have done analyses of (60) Co-irradiated samples and kinetic studies using pulsed electron beams. For aryl halides containing no more than two fused rings, the main products detected are those of simple halogen replacement by hydrogen, although the amount of aryl halide destroyed was always greater than the total amount of products detected. To accomplish halogen replacement by H, the reaction solvent may not be pure water but must contain a hydrogen source such as an aliphatic alcohol. The absence of such an additive, results in products of aryl radical addition to aryl halide. The necessary amount of additive required is quite small for halobenzenes. With aryl halides of three (and presumably more than three) fused rings, the radical-anion intermediates either undergo conversion to halogen-containing dihydroarenes, or lose halogen to form radicals which resist reaction with H-donating additive and thus form timers. When aryl halides are solubilized in micelle-forming detergent solutions, the detergent molecules serve as hydrogen atom sources. Conversions are highest with cat ionic detergents. GRA

N93-24645# National Geophysical Data Center, Boulder, CO.
GLOBAL ECOSYSTEMS DATABASE. VERSION 1.0 (ON CD-ROM). EPA GLOBAL CLIMATE RESEARCH PROGRAM. NOAA/NGDC GLOBAL CHANGE DATABASE PROGRAM. DOCUMENTATION MANUAL, DISC-A. VOLUME 1. NGDC KEY TO GEOPHYSICAL RECORDS DOCUMENTATION NO. 27
J. J. Kineman and M. A. Ohrenschall Jun. 1992 247 p Sponsored by Corvallis Environmental Research Lab., OR
(PB93-146090; EPA/600/R-92-194B) Avail: CASI HC A11/MF A03

The Documentation Manual contains descriptive information about each data-set and exact file descriptions for each element in the data-set. The data-set descriptions are structured according to a precise template that is described in detail (Documentation Template Definitions). The Data-Set Description provides an in-depth identification and tracking of the data-set and its technical properties, and gives key references for the data-set. At the end of this description is a summary of any Data Integration and Quality work associated with the project. Such work may range from simple format conversion to complicated re-structuring, interpolation, and testing. A user's guide is provided as a separate document. In addition to their printed versions, the User's Guide and Documentation Manuals are provided in computer-readable form (bit-mapped image format) on the CD-ROM's. Reprints of the Primary References, including published journal articles, if applicable, are provided separately from the Documentation Manual as scanned image files on the CD-ROM. Reprints are assembled from available reports and publications, with permission from the authors and publishers. Only materials that are directly relevant to documenting the data-sets are reproduced. GRA

N93-23511# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
COLLECTION AND DISTRIBUTION OF ECOLOGICAL DATA BY SATELLITE: CDEDS
F. Gampe, K.-P. Graf (Elektronik-System G.m.b.H., Munich, Germany.), and G. Solari *In its* Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 19-23 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23512# Elektronik-System G.m.b.H., Munich (Germany).
COLLECTION AND DISTRIBUTION OF ECOLOGICAL DATA BY SATELLITE PILOT PROJECTS AS DEMONSTRATION OF THE CONCEPT
K.-P. Graf and F. Gampe (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 25-31 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23560# Swedish Space Corp., Solna.
EXTRACTION OF INFORMATION FROM SATELLITE IMAGERY TO A GIS FOR ENVIRONMENTAL MONITORING OF THE MINING AREAS IN NORTHEASTERN ESTONIA
M. Oeberg, T. Lindell (Uppsala Univ., Sweden.), J. Nisell (Uppsala Univ., Sweden.), and L. Saare (Estonia Nature Management Scientific Information Centre, Tallinn.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 311-315 Presented at 3rd European Conference on Geographical Information Systems (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23578# Technische Univ., Berlin (Germany). Inst. fuer Geologie-Geoinformatik.
ANALYSIS OF HUMAN IMPACT ON DEGRADATION AND DESERTIFICATION OF THE WEST AFRICAN SAHEL BY MEANS OF MULTI-LEVEL REMOTE SENSING TECHNIQUES

E. Csaplovics *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 413-416 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23833# Canada Centre for Remote Sensing, Ottawa (Ontario).
GEOSCOPE: AN INTERACTIVE GLOBAL CHANGE ENCYCLOPEDIA
Rejean Simard *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1373-1377 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23834# National Geophysical Data Center, Boulder, CO.
INTEGRATED GLOBAL ENVIRONMENTAL (GLOBAL CHANGE) DATA ACTIVITIES SUPPORT RESEARCHERS AND EDUCATORS
David A. Hastings, David M. Clark, and John J. Kineman *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1379-1382 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23841# United Nations, New York, NY. Outer Space Office.
SPACE ACTIVITIES AND ENVIRONMENTAL PROTECTION: ROLE OF THE UNITED NATIONS
N. Jasentuliyana and Ralph Chipman *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1417-1422 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24337# European Space Agency, Paris (France). Space Station and Microgravity Div.
COLUMBUS PROGRAMME OVERVIEW
F. Engstroem *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 9-10 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N93-22077# Los Alamos National Lab., NM.
REPORT OF THE WORKING GROUP ON MAGNETOTAIL/PLASMA SHEET STRUCTURE
J. Birn and D. Fairfield (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) 1992 11 p Presented at the Geospace Environment Modeling Workshop on Magnetotail/Substorms, Snowmass, CO, 2-3 Jul. 1992
(Contract W-7405-eng-36)
(DE93-003857; LA-UR-92-3845; CONF-9207168-1) Avail: CASI HC A03/MF A01

The magnetotail and its imbedded plasma sheet represent the major region where excess energy is stored in the magnetosphere. It is consequently the principal site where energy release starts and magnetospheric activity is initiated. The qualitative understanding and quantitative description of its average and instantaneous structure and its dependence on solar wind and ionospheric boundary conditions are therefore at the core of magnetospheric physics and modeling. The assessment of present knowledge and open questions concerning the average tail and its instantaneous structure during steady periods or for changes that are slow in comparison to the fast dynamic scale of magnetospheric substorms are addressed. Quantitatively, one might draw a distinction at about 1 minute, which is slightly larger than a typical magnetosonic (or Alfven) wave propagation time over a characteristic macroscopic scale of a few Earth radii. This restriction not only excludes the fast dynamic evolution after substorm (expansive phase) onset but also time-dependent phenomena such as waves, eigenmodes, etc. that are not necessarily related to substorm activity. Questions of stability are excluded. The major goal within this area consists of the construction and improvement of quantitative models, empirical and selfconsistent, at various levels of sophistication as required by particular applications. Such models not only represent the quantification of observations and physical understanding of the magnetospheric structure but also are needed as the basis for a variety of further investigations, such as test particle studies, stability analyses, and MHD simulations.
DOE

N93-22380# National Center for Atmospheric Research, Boulder, CO. Mesoscale and Microscale Meteorology Div.
USER'S GUIDE TO THE PENN STATE/NCAR MESOSCALE MODELING SYSTEM Technical Note
David O. Gill Oct. 1992 230 p Sponsored by National Science Foundation, Washington, DC
(PB93-126654; NCAR/TN-381+IA) Avail: CASI HC A11/MF A03

An updated version of the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Modeling system (the MM4 system) is presented. The standard MM4 modeling package employs a Cressman multi-scan isobaric and surface analysis, with a hydrostatic predictive component using a leap frog integration of the flux form of the primitive equations on sigma coordinates. An experimental version has expanded the data ingest routines to allow hybrid isentropic-isobaric + surface analyses. Experimental versions of the model allow split-explicit time integration, several cumulus parameterizations coupled with an explicit moisture scheme, multiple levels of movable nests, relaxation of the hydrostatic assumptions, additional planetary boundary layer schemes, and microphysical packages. Due to the developmental nature of the modeling system, periodic upgrades in documentation are required to keep the manuals in accord with the programs. The document supersedes Penn State/NCAR Mesoscale Model User's Manual--Ver 8.
GRA

N93-22530# Lawrence Livermore National Lab., CA.
A COMPARISON OF DECONVOLUTION TECHNIQUES
C. J. Ammon Aug. 1992 43 p
(Contract W-7405-eng-48)
(DE93-007407; UCRL-ID-111667) Avail: CASI HC A03/MF A01

In the following, I compare several approaches to the deconvolution of a wavelet from a seismogram, when the wavelet can be estimated beforehand. Specifically, I examine the frequency domain waterlevel method, a least-squares, frequency-dependent weighting scheme, and a time-domain approach using the Singular Value Decomposition. I illustrate each deconvolution technique by estimating receiver functions using both high quality and low quality seismic waveforms. Each technique performs well with high quality data, and all have problems with noisy data. In cases where the data do not allow a complete extraction of desired information, the time domain approach is the more useful method to interpret the resulting waveforms. Singular Value Decomposition also permits an optimal combination of information from several deconvolutions or a quantitative comparison of the results from several deconvolutions. Additionally, the time domain approach is readily adaptable to multi-waveform deconvolution.
DOE

N93-22685*# Alabama Univ., Huntsville.
INNER MAGNETOSPHERE IMAGER (IMI) INSTRUMENT HERITAGE
G. R. Wilson Mar. 1993 31 p
(Grant NGT-01-002-099)
(NASA-CR-4498; M-714; NAS 1.26:4498) Avail: CASI HC A03/MF A01

This report documents the heritage of instrument concepts under consideration for the Inner Magnetosphere Imager (IMI) mission. The proposed IMI will obtain the first simultaneous images of the component regions of the inner magnetosphere and will enable scientists to relate

these global images to internal and external influences as well as local observations. To obtain simultaneous images of component regions of the inner magnetosphere, measurements will be made of: (1) the ring current and inner plasma sheet using energetic neutral atoms; (2) the plasmasphere using extreme ultraviolet; (3) the electron and proton auroras using far ultraviolet and x rays; and (4) the geocorona using FUV. Instrument concepts that show heritage and traceability to those that will be required to meet the IMI measurement objectives are described. Author (revised)

N93-22806# Los Alamos National Lab., NM.
EFFECTS OF UGTs ON THE IONOSPHERE
P. E. Argo and T. J. Fitzgerald 1992 18 p Presented at the RAS/VERTIC Symposium on Verification of Nuclear Testing Treaties, London, England, 14 Feb. 1992
(Contract W-7405-eng-36)
(DE93-000793; LA-UR-92-2909; CONF-9202138-1) Avail: CASI HC A03/MF A01

The processes that propagate local effects of underground nuclear tests from the ground into the upper atmosphere, and produce a detectable signal in the ionosphere are described. Initially, the blast wave from a underground test (UGT) radially expands, until it reaches the surface of the earth. The wave is both reflected and transmitted at this sharp discontinuity in propagation media. The reflected wave combines with the incident wave to form an 'Airy surface,' at which very strong ripping forces tear the earth apart. This broken region is called the 'spat zone,' and is launched into ballistic motion. The resultant ground motion launches an acoustical wave into the atmosphere. This acoustic wave, with overpressures of a few tenths of one percent, propagates upwards at the speed of sound. Assuming purely linear propagation, the path of the acoustic energy can be tracked using raytracing models. Most of the wave energy, which is radiated nearly vertically, tends to propagate into the upper atmosphere, while wave energy radiated at angles greater than about 30 degrees to the vertical will be reflected back to earth and is probably what is seen by most infrasonde measurements. DOE

N93-22807# Los Alamos National Lab., NM.
THE 3-D NUMERICAL INVESTIGATION OF THE MANTLE DYNAMICS ASSOCIATED WITH THE BREAKUP OF PANGEA
J. R. Baumgardner 1992 19 p Presented at the NATO Advanced Study Institute on Dynamics Modeling and Flow in the Earth and Planets, Fairbanks, AK, Jun. 1991
(Contract W-7405-eng-36)
(DE93-000796; LA-UR-92-2943; CONF-9106401-1) Avail: CASI HC A03/MF A01

Three-dimensional finite element calculations in spherical geometry are performed to study the response of the mantle with platelike blocks at its surface to an initial condition corresponding to subduction along the margins of Pangea. The mantle is treated as an infinite Prandtl number Boussinesq fluid inside a spherical shell with isothermal, undeformable, free-slip boundaries. Nonsubducting rigid blocks to model continental lithosphere are included in the topmost layer of the computational mesh. At the beginning of the numerical experiments these blocks represent the present continents mapped to their approximate Pangean positions. Asymmetrical downwelling at the margins of these nonsubducting blocks results in a pattern of stresses that acts to pull the supercontinent apart. The calculations suggest that the breakup of Pangea and the subsequent global pattern of seafloor spreading was driven largely by the subduction at the Pangean margins. DOE

N93-22894# Geological Survey, Reston, VA.
TEXT AND REFERENCES TO ACCOMPANY 'MAP SHOWING THE THICKNESS AND CHARACTER OF QUATERNARY SEDIMENTS IN THE GLACIATED UNITED STATES EAST OF THE ROCKY MOUNTAINS'
David R. Soller 1992 64 p
(PB93-129864; USGS-BULL-1921; LC-90-3388) Avail: CASI HC A04/MF A01

A 1:1,000,000-scale map of quaternary deposits has been compiled for the glaciated area of the United States east of the Rocky Mountains. Parts of southern Ontario, areas beneath the Great Lakes, and parts of the submerged eastern seaboard are also included on the map. The map has three components that, together, provide the first regional three-dimensional view of these deposits. These map components are the surface distribution of quaternary sediments, the total thickness of quaternary sediments, and the distribution of significant buried quaternary units. For many areas, this is the first map of the quaternary sediment thickness published at any scale. The report provides supporting information for the map, preliminary interpretations or sediment distribution, and the list of geologic sources used to generate the map. Author

N93-23029# California Inst. of Tech., Pasadena.
ISOTOPE TRACER STUDIES OF DIFFUSION IN SILICATES AND OF GEOLOGICAL TRANSPORT PROCESSES USING ACTINIDE ELEMENTS
G. J. Wasserburg 1992 21 p
(Contract DE-FG03-88ER-13851)
(DE93-006902; DOE/ER-13851/T2) Avail: CASI HC A03/MF A01

The following are reported: high abundance sensitivity mass spectrometer for U-Th studies; U-238 - Th-230 disequilibrium in recent lavas from Iceland; water-rock interaction from U-Th studies; resonance ionization mass spectrometry of Os and Ti isotopes; and self-diffusion of Mg. DOE

N93-23124*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CHEMICAL KINETICS AND PHOTOCHEMICAL DATA FOR USE IN STRATOSPHERIC MODELING
W. B. DeMore, S. P. Sander, D. M. Golden (SRI International Corp., Menlo Park, CA.), R. F. Hampson (National Inst. of Standards and Technology, Gaithersburg, MD.), M. J. Kurylo (National Inst. of Standards and Technology, Gaithersburg, MD.), C. J. Howard (National Oceanic and Atmospheric Administration, Boulder, CO.), A. R. Ravishankara (National Oceanic and Atmospheric Administration, Boulder, CO.), C. E. Kolb (Aerodyne Research, Inc., Billerica, MA.), and M. J. Molina (Massachusetts Inst. of Tech., Cambridge.) 15 Aug. 1992 250 p
(Contract NAS7-918)
(NASA-CR-192795; NAS 1.26:192795; JPL-Publ-92-20) Avail: CASI HC A11/MF A03

As part of a series of evaluated sets, rate constants and photochemical cross sections compiled by the NASA Panel for Data Evaluation are provided. The primary application of the data is in the modeling of stratospheric processes, with particular emphasis on the ozone layer and its possible perturbation by anthropogenic and natural phenomena. Copies of this evaluation are available from the Jet Propulsion Laboratory. Author (revised)

N93-23135# Maryland Univ., College Park.
NONLINEAR DYNAMICAL MODELING AND PREDICTION OF THE TERRESTRIAL MAGNETOSPHERIC ACTIVITY Ph.D. Thesis
Dimitris Vassiliadis 1992 170 p
Avail: Univ. Microfilms Order No. DA9234675

The irregular activity of the magnetosphere results from its complex internal dynamics as well as the external influence of the solar wind. the dominating self-organization of the magnetospheric plasma gives rise to repetitive, large-scale coherent behavior manifested in phenomena such as the magnetic substorm. Based on the nonlinearity of the global dynamics this dissertation examines the magnetosphere as a nonlinear dynamical system using time series analysis techniques. Initially the magnetospheric activity is modeled in terms of an autonomous system. A dimension study shows that its observed time series is self-similar, but the correlation dimension is high. The implication of a large number of degrees of freedom is confirmed by other state space techniques such as Poincare sections and search for unstable periodic orbits. At the same time a stability study of the time series in terms of Lyapunov exponents suggests that the series is not chaotic. The absence of deterministic chaos is supported by the low predictive capability of the autonomous model. Rather than chaos, it is an external input which is largely responsible for the irregularity of the magnetospheric activity. In fact, the external driving is so strong that the above state space techniques give results for magnetospheric and solar wind time series that are at least qualitatively similar. Therefore the solar wind input has to be included in a low-dimensional nonautonomous model. Indeed it is shown that such a model can reproduce the observed magnetospheric behavior up to 80-90 percent. The characteristic coefficients of the model show little variation depending on the external disturbance. The impulse response is consistent with earlier results of linear prediction filters. The model can be easily extended to contain nonlinear features of the magnetospheric activity and in particular the loading-unloading behavior

of substorms. The above results encourage the use of low-dimensional driven models for the solar wind-magnetosphere coupling. Dissert. Abstr.

N93-23190 Toronto Univ. (Ontario).
USE OF GEODETIC METHODS IN DETECTING TERRAIN MOVEMENTS WITH SPECIAL REFERENCE TO THE GLOBAL POSITIONING SYSTEM Ph.D. Thesis
Mohamed Fathy Hassan El-Maghraby 1991 251 p
(ISBN-0-315-69179-4) Avail: Univ. Microfilms Order No. DANN69179

Subsurface movements are monitored using geotechnical instruments. The geodetic-terrestrial methods are suitable for detecting surface deformations; but they are limited by the requirements of stations' inter-visibility and favorable weather conditions. The Global Positioning System (GPS) is not so restricted. There are several types of GPS receivers. The associated software estimates the baseline components and provides a number of quality parameters. However, the literature on the application of GPS to terrain movement studies does not provide guidance regarding the appropriate length of an observing session and it lacks a procedure to evaluate the anticipated error of each estimate. These issues are investigated experimentally for lines up to 500 m and observing sessions up to 60 minutes. The data were collected in 1989 under favorable and unfavorable conditions with Trimble receivers and processed using the Trimvec software in full sessions as well as 15-minute sub-sessions. The analysis shows that the estimates derived from bias-fixed-at-integer solutions are the only reliable estimates. Ninety six percent of all such estimates of L1 carrier frequency data from 15-minute observations have baseline length errors less than 5 cm and height difference errors less than 10 cm. The corresponding numbers for estimates from full sessions are 2 cm and 5 cm. Further analysis of the data shows that the individual quality parameters are not reliable identifiers of accuracy. Combined in linear discriminant functions these parameters are shown to provide a powerful means of classifying individual estimates. The effectiveness of this approach is demonstrated by verifying the discriminant-function classification of baseline length and height difference from 15-minute observations at the 2 cm and 5 cm accuracy level, respectively; and the height difference for 40 to 60-minute session at the 2 cm level. It is concluded that terrain movements of 20-50 mm over a distance of up to 500 m can be detected if the terminals of the baseline are occupied repeatedly for 40 to 60-minutes. Movements greater than 50 mm can be detected by repeated 15-minute observations. Smaller movements are more reliably monitored with geodetic-terrestrial methods. Dissert. Abstr.

N93-23207 Miami Univ., Coral Gables, FL.
THE EFFECT OF CURRENT-INDUCED STRESS PERTURBATION ON LARGE- AND MESO-SCALE AIR-SEA INTERACTIONS Ph.D. Thesis
Lian Xie 1992 175 p
Avail: Univ. Microfilms Order No. DA9239673

The effect of the stress modulation by the surface currents is studied using a quadratic stress law, for various physical processes in the atmosphere-ocean system. In the presence of surface currents, a stress perturbation is induced by the current structure because of a modulation of the velocity shear at the air-sea interface. In the case of a unidirectional current and a uniform wind, it is proportional to and opposing the surface current vorticity. This causes a spindown effect on the surface vorticity field at a rate proportional to the wind speed. In the steady state, or in slowly varying processes which can be treated as parametrically developing quasi-steady states, the surface layer potential vorticity modulation causes up- and down-welling patterns associated with the surface-current vorticity. These effects are analyzed, first in a 2.5-layer quasi-geostrophic (QG) f-plane system and then in a two-layer as well as in a continuously stratified QG beta-plane system. The f-plane solution shows that the damping effect is effectively limited to the surface layer. The beta-plane solution shows that the perturbation stress induced by the surface current is an important damping mechanism for the baroclinic Rossby waves. The responses of the tropical atmosphere-ocean system to the current-induced stress perturbation are explored in a simple coupled model. We find that in the absence of mean currents the current-induced stress perturbation imposes a damping effect on both sides of the air-sea interface. In the presence of a mean current, the stress perturbation created by the mean current imposes a damping effect on the mean current itself, but can enhance the perturbation flow field through momentum exchanges between the two mediated by the interface stress. The coupling strength of the atmosphere-ocean system is thus modulated by the stress perturbation. Finally, the reactionary effect of the current induced stress perturbation on the atmospheric boundary-layer flow is briefly discussed. Computations for simple current patterns and constant large-scale winds show that substantial updraft at the top of the trade wind boundary layer can be produced by the ageostrophic transport divergence induced mechanically by an intense oceanic jet.
Dissert. Abstr.

N93-23211*# Colorado Univ., Boulder. Astrophysical Planetary and Atmospheric Sciences Dept.
A PROPOSED NEUTRAL LINE SIGNATURE
I. Doxas, T. W. Speiser, P. B. Dusenbery, and W. Horton (Texas Univ., Austin.) [1992] 22 p
(Grant NAGw-2968)
(NASA-CR-192335; NAS 1.26:192335) Avail: CASI HC A03/MF A01

An identifying signature is proposed for the existence and location of the neutral line in the magnetotail. The signature, abrupt density, and temperature changes in the Earthtail direction, was first discovered in test particle simulations. Such temperature variations have been observed in ISEE data (Huang et. al. 1992), but their connection to the possible existence of a neutral line in the tail has not yet been established. The proposed signature develops earlier than the ion velocity space ridge of Martin and Speiser (1988), but can only be seen by spacecraft in the vicinity of the neutral line, while the latter can locate a neutral line remotely. Author

N93-23249 York Univ. (England).
PHYSICAL AND DIRECT METHODS IN CRYSTALLOGRAPHY Ph.D. Thesis
Adam Charles Ralph 1991 135 p
Avail: Univ. Microfilms Order No. BRDX97542

This work consists of two main parts, with the one intention of extending the size of structures that can be solved by direct methods. The first part adapts a physical method which uses anomalous scattering data. The anomalous differences in conjunction with the positions of the anomalous scatterers create two possible values for each phase. This ambiguity makes the process of phase refinement easier. Two methods, the MPS method and the Wilson distribution method, are used to break the phase ambiguity. They are tested on two structures, avian pancreatic polypeptide (APP) which crystallizes in C2 and has 36 amino acid residues per asymmetric unit and ribonuclease Sa (RNA) which crystallizes in P2(1)2(1)2(1) and has 192 amino acid residues per asymmetric unit. Both methods are successful in solving APP but both are unsuccessful with RNA. Thus, this indicates a limit to the size of the structure that can be solved using these methods. The second part consists of refining phases by analyzing the determinant of a Karle-Hauptman matrix. This method is tested on a small structure, MUNICH, which crystallizes in C2 and has 160 carbon atoms in the unit cell. For each value of the determinant there are an infinite number of matrices related by similarity transforms. Therefore, the matrix is reformed so that three phase invariants are refined. It is found that the matrix determinant must be refined to zero, using a suitable matrix, in order for the phases to be refined successfully. More research needs to be carried out before any hard judgements can be made as to the suitability of using Karle-Hauptman matrices on larger structures. Dissert. Abstr.

N93-23252# National Center for Atmospheric Research, Boulder, CO. Mesoscale and Microscale Div.
DATA INGEST AND OBJECTIVE ANALYSIS FOR THE PSU/NCAR MODELING SYSTEM. PROGRAMS DATAGRID AND RAWINS
Kevin W. Manning and Philip L. Haagenson Oct. 1992 220 p Sponsored by NSF
(PB93-138519; NCAR/TN-376+IA) Avail: CASI HC A10/MF A03

Two components of the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) modeling system, DATAGRID and RAWINS, access all of the meteorological data for the forecast model. DATAGRID accesses historical coarse-resolution analyses supplied by the National Meteorological Center (NMC) or the European Center for Medium-range Weather Forecasts (ECMWF), or real-time forecasts from the NMC's Medium Range Forecast model. GRA

N93-23255# Texas Univ., Austin. Bureau of Economic Geology.
REGIONAL GEOLOGY OF THE LOW-PERMEABILITY, GAS-BEARING CLEVELAND FORMATION, WESTERN ANADARKO BASIN, TEXAS PANHANDLE: LITHOLOGIC AND DEPOSITIONAL FACIES, STRUCTURE, AND SEQUENCE STRATIGRAPHY Topical Report, Jan. 1989 - Dec. 1991
Tucker F. Hentz Sep. 1992 149 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5082-211-0708)
(PB93-132769; GRI-92/0459) Avail: CASI HC A07/MF A02

The Upper Pennsylvania (lower Missourian) Cleveland formation produces gas from low-permeability ('tight') sandstone reservoirs in the western Anadarko Basin of the northeastern Texas Panhandle. In the six-county region, these reservoirs had produced more than 412 Bcf of natural gas through December 31, 1989. Because of their typically low permeability, the Cleveland sandstones require acidizing and hydraulic fracture treatment to produce gas at economic rates. Since 1982, the Gas Research Institute has supported geological investigations throughout the United States to develop the scientific and technological knowledge for producing from low-permeability, gas-bearing sandstones. As part of the program and the GRI Tight Gas Sands project, the Bureau of Economic Geology has been conducting research on low-permeability sandstones in the Cleveland formation and on several other sandstone units of similar character in Texas and Wyoming. Author

N93-23320# Argonne National Lab., IL.
MASSIVELY PARALLEL IMPLEMENTATION OF THE PENN STATE/NCAR MESOSCALE MODEL
I. Foster and J. Michalakes 1992 5 p Presented at the 73rd American Meteorological Society Annual Meeting, Anaheim, CA, 17-22 Jan. 1993
(Contract W-31-109-eng-38)
(DE93-004874; ANL/CP-77502; CONF-930133-6) Avail: CASI HC A01/MF A01

Parallel computing promises significant improvements in both the raw speed and cost performance of mesoscale atmospheric models. On distributed-memory massively parallel computers available today, the performance of a mesoscale model will exceed that of conventional supercomputers; on the teraflops machines expected within the next five years, performance will increase by several orders of magnitude. As a result, scientists will be able to consider larger problems, more complex model processes, and finer resolutions. In this paper. we report on a project at Argonne National Laboratory that will allow scientists to take advantage of parallel computing technology. This Massively Parallel Mesoscale Model (MPMM) will be functionally equivalent to the Penn State/NCAR Mesoscale Model (MM). In a prototype study, we produced a parallel version of MM4 using a static (compile-time) coarse-grained 'patch' decomposition. This code achieves one-third the performance of a one-processor CRAY Y-MP on twelve Intel 1860 microprocessors. The current version of MPMM is based on all MM5 and uses a more fine-grained approach, decomposing the grid as finely as the mesh itself allows so that each horizontal grid cell is a parallel process. This will allow the code to utilize many hundreds of processors. A high-level language for expressing parallel programs is used to implement communication streams between the processes in a way that permits dynamic remapping to the physical processors of a particular parallel computer. This facilitates load balancing, grid nesting, and coupling with graphical systems and other models. DOE

N93-23353 Florida State Univ., Tallahassee.
IMPACT OF A NEWTONIAN ASSIMILATION AND PHYSICAL INITIALIZATION ON THE INITIALIZATION AND PREDICTION IN A TROPICAL MESOSCALE MODEL Ph.D. Thesis
Kok-Seng Yap 1992 254 p
Avail: Univ. Microfilms Order No. DA9234261

One of the major limitations of tropical hydrostatic mesoscale models initialized through synoptic and subsynoptic scale data and operating on a grid resolution of 20-50km is that they show limited skill in simulating the spatial and temporal distribution of precipitation despite well-predicted synoptic and subsynoptic-scale flow patterns. In general the models show a precipitation spin-up phase, however once activated, the model tends to become convectively overactive through the synoptic scale-mesoscale feedback mechanism. Our experience suggests that for the tropics where the mesoscale circulations are convectively active, the precipitation spin-up arises from the inability of the initial synoptic-scale analysis to produce dynamic, thermodynamic and moisture fields capable of supporting convection of the mesoscale. In particular, the problem lies in the wrong initial analysis of the velocity divergence and moisture fields. The overactive convection in the model arises when the model fails to initiate convection over some of the areas that are observed to precipitate, hence feeding the available moisture into the model activated regions. It is shown in this study that this spin-up and overactive convection problem can be overcome by carrying out a dynamic Newtonian assimilation coupled with physical initialization during a preforecast integration phase of the model. In particular it is shown that the Newtonian assimilation of the rotational component of the wind and surface pressure coupled with physical initialization of surface fluxes of moisture, cumulus parameterization and outgoing longwave radiation (OLR) enables the model to build the divergence and moisture fields at the required location. The cumulus initialization is done through a humidity reanalysis via a 'Reverse Kuo' algorithm. The surface latent heat flux initialization is done by reanalysis of the model's lowest level humidity fields through a 'Reverse similarity algorithm', and the OLR initialization is done through a humidity reanalysis at the upper levels by matching the model OLR with satellite observations. Dissert. Abstr.

N93-23387 Maryland Univ., College Park.
LONG PERIOD PULSATION EVENTS IN ELECTRON PRECIPITATION AND MAGNETIC FIELDS AT THE SOUTH POLE Ph.D. Thesis
John Anthony Paquette 1992 161 p
Avail: Univ. Microfilms Order No. DA9234636

Geomagnetic pulsation events with long (100-1000 second) periods that are accompanied by electron precipitation pulsations at the same frequency were reported at various latitudes. A search of the data from South Pole station for the period from 1982 to 1989 revealed over 200 such events. A comparison of these events with the predictions of Coroniti and Kennel (1970) was undertaken, including examination of VLF data, interplanetary magnetic field data, DMSP satellite data, and data from South Pole's conjugate station at Iqaluit, as well as the riometer and magnetometer data from South Pole used in the original search. Data from the IRIS Imaging Radiometer were also used when available. A consideration of the respective wave and particle transit times from the magnetic equator to the ground leads to an expectation that the onset of pulsations in the magnetometer data will lag the onset of pulsations in the riometer data by several minutes. This disparity in onset times, together with VLF modulation in the proper frequency range, serve as important indicators of whether or not an event can be explained by the above-cited theory. While about a third of the events fit the prediction of Coroniti and Kennel, another third cannot be explained by this theory, and possible alternative mechanisms are explored. The remaining third of the events appear at first to be inexplicable in terms of any transit time argument, but analysis of the IRIS data shows that this third class of events arises from differences in the spatial coverage of the instruments. Dissert. Abstr.

N93-23388 Cornell Univ., Ithaca, NY.
TRANSVERSE ION ACCELERATION BY LOCALIZED LOWER HYBRID WAVES IN THE TOPSIDE AURORAL IONOSPHERE Ph.D. Thesis
Jorge Luis Vago 1992 147 p
Avail: Univ. Microfilms Order No. DA9236075

Up to now, observations had been unable to show conclusively a one-to-one correspondence between perpendicular ion acceleration and a particular type of plasma wave within the O(+) source region below 2000 km. In this thesis, we demonstrate that intense (100-300 mV/m) lower hybrid waves are responsible for transversely accelerating H(+) and O(+) ions to characteristic energies of up to 6 eV. This wave-particle interaction takes place in thin filamentary density cavities oriented along geomagnetic field lines. The measurements we discuss were conducted in the nightside auroral zone at altitudes between 500 km and 1100 km. Our results are consistent with theories of lower hybrid wave condensation and collapse. Dissert. Abstr.

N93-23478# Boston Univ., MA.
METALLIC IONS AND ATOMS IN THE UPPER ATMOSPHERE Annual Report, 1 Jan. - 31 Dec. 1992
Jeffrey M. Forbes and R. G. Roble 15 Oct. 1992 14 p

(Contract F49620-92-J-0092)
(AD-A259741; AFOSR-92-1009TR) Avail: CASI HC A03/MF A01

The main focus of research under AFOSR Grant F49620-92-J-0092 is to investigate the global and local transport of metallic ions in the upper atmosphere, in particular the layering of ionization, through use of comprehensive numerical models which account for realistic meteoric sources, chemical conversions and sinks, and transport by molecular and eddy diffusion, winds, and electric fields. The ultimate goal is to better understand the mechanisms producing ionization layers, and ultimately the seasonal, latitudinal, local time, and temporal variations in the occurrences of ionization layers. Plasma layering can affect HF communications by introducing new reflection paths thus complicating the propagating modes, and presumably in extreme cases by producing blanketing effects. In addition, plasma irregularities may also accompany the sharp gradients characterizing the plasma layers. GRA

N93-23480# Boston Univ., MA.
SOURCE MECHANISMS AND RADIO EFFECTS OF IONOSPHERIC PLASMA Annual Report, 1 Oct. 1991 - 30 Sep. 1992
Min-Chang Lee 1 Nov. 1992 57 p Prepared in cooperation with Massachusetts Inst. oof Technology Plasma Fusion Center, Cambridge, MA
(Contract F49620-92-J-0001)
(AD-A259743; AFOSR-92-1007TR) Avail: CASI HC A04/MF A01

Since October 1, 1991 experimental and theoretical research has been conducted by Prof. Min-Chang Lee and his students at BU and MIT. This research work is aimed at investigating the ionospheric plasma disturbances which can affect significantly the radio wave propagation in communications and space surveillance. The research topics which have been investigated include: (1) A source mechanism leading to the symmetric lower hybrid sidebands and a low-frequency mode in the upper atmosphere, (2) Characteristics of lightning-induced plasmas, (3) Radio wave-produced plasmas and effects on radio communications, and (4) Plasma turbulence and formation of field aligned density fluctuations as ionospheric ducts. GRA

N93-23493 Arkansas Univ., Fayetteville.
PHOTOACOUSTIC DETERMINATION OF THE SINGLE-SCATTERING ALBEDO OF CARBONACEOUS PARTICULATES Ph.D. Thesis
Duane Allen Jackson 1991 134 p
Avail: Univ. Microfilms Order No. DA9237386

Measurements of light absorption and light scattering coefficients of carbon particles in air suspension, with approximate diameters ranging from 0.59 microns to 0.66 microns, have been made by photoacoustic spectroscopy and nephelometry, respectively. The mean absorption coefficient of these aerosols found by photoacoustic spectroscopy was 3.8 x 10(exp -5) m(exp -1) as compared to a mean of 1.2 x 10(exp -5) m(exp -1) calculated from Mie scattering theory. Nephelometer measurements gave a mean volume scattering coefficient of 8 x 10(exp -5) m(exp -1), and Mie theory calculations give a corresponding value of 1.2 x 10(exp -5) m(exp -1). From the photoacoustic spectroscopy and nephelometry measurements, a single-scattering albedo of 0.65 is implied for the carbon particles. Carbon aerosol samples were generated by atomizing a suspension of carbon black in alcohol, and carbon particle mass concentrations in the aerosol were determined by aethalometer analysis. From the known carbon mass concentrations in the aerosol, the detection limit of the longitudinally resonant spectrophone used for measuring the light absorption coefficient, beta(sub ab), was found to be 10(exp -5) m(exp -1) for a signal-to-noise ratio equal to one. This value corresponds to a carbon mass concentration detection limit of approximately 1 micro-g/cu m. Carbon particle size distributions were measured using a Single Particle Aerodynamic Relaxation Time Analyzer. The aerodynamic diameter of the carbon particles ranged from 0.59 to 0.66 microns with corresponding geometric standard deviations of 1.23 to 1.28. A morphological analysis of the carbon particles was done by scanning electron microscopy on samples deposited on filter substrates. This analysis showed carbon particles occurring as irregularly shaped agglomerates. The correlation between the carbon aerosol mass concentrations as measured by aethalometer analysis and light absorption coefficients measured by photoacoustic spectroscopy shows that the photoacoustic method can be used for monitoring atmospheric soot concentrations of airborne particles with measurement times less than 60 s. Dissert. Abstr.

N93-23595 Cornell Univ., Ithaca, NY.
ON THE HIERARCHY OF PROCESSES CONTRIBUTING TO EQUATORIAL SPREAD F Ph.D. Thesis
David Lee Hysell 1992 419 p
Avail: Univ. Microfilms Order No. DA9300769

Unstable plasma stratification in the twilight equatorial F region ionosphere is subject to plasma instabilities known collectively as equatorial spread F. Small-scale irregularities in electron density give rise to coherent VHF and UHF radio scatter during spread F while in situ spacecraft detect intermediate- and large-scale plasma structures. We present data from observations made over three years at the Jicamarca Radio Observatory and from the summer 1990 CRRES/EQUIS campaign which involved the Cornell 50 MHz radar interferometer (CUPRI) and the Altair UHF radar at Kwajalein, MI. Radar findings are correlated with spread F data from sounding rockets launched during the EQUIS project and from the Atmospheric Explorer E satellite. A review of fundamental fluid theory for the ionospheric interchange instability emphasizes dissipative and non-local effects that restrict linear instability to intermediate-scale wavelengths. A nonlinear fluid theory incorporating three wave interactions extends the range of instability to transitional and small scales, and renormalization group analysis offers a way to evaluate enhanced transport due to these nonlinearly excited modes. At large scales, circumstantial evidence suggests that internal gravity waves seed plasma upwellings and initiate topside spread F. Density and electric field spectra measured by the spread F sounding rockets exhibit inertial-convective and inertial-diffusive subranges. A model of quasi one-dimensional plasma turbulence reproduces the spectral indices and breaking scales observed by the rockets. Density power spectra from 30 AE-E orbits also possess convective and diffusive subranges, but their characteristic scale sizes are about 10 times larger than the rocket's. One-dimensional rocket and satellite power spectra combine to form a two-dimensional spectral model of F region irregularities which predicts VHF radar scattering cross-sections. Seeking predictions for bottomside spread F coherent scatter Doppler spectra, we couple a particle-in-cell code to the intermediate scale plasma fluid simulation developed by Zargham and Seyler (1989). Our results distinguish between Doppler spectra and line-of-sight velocity distributions and suggest that there can be additional spectral broadening due to short growth times of the scattering waves. On the basis of new aspect sensitivity data from Jicamarca, we propose that collisional drift waves may join the nonlinear interchange mode as a source of 3 meter backscatter. Drift waves are linearly damped by ion-ion collisions at 3 meters, but a nonlinear, quasikinetic model predicts instability under certain conditions. Dissert. Abstr.

N93-23632# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
COUPLING AN OCEAN WAVE MODEL TO AN ATMOSPHERIC GENERAL CIRCULATION MODEL
Susanne L. Weber (Royal Netherlands Meteorological Inst., De Bilt.), Hans vonStorch, Pedro Viterbo (European Centre for Medium-Range Weather Forecasts, Reading, England.), and Liana Zambresky (GKSS-Forschungszentrum Geesthacht, Germany.) Sep. 1991 33 p
(Grant EPOC-0003-C)
(MPIM-72; ETN-93-93667) Avail: CASI HC A03/MF A01

A coupled model, consisting of an ocean wave model and an Atmospheric General Circulation Model (AGCM), is integrated under permanent July conditions. The wave model is forced by the AGCM wind stress, whereas the effect of the ocean waves is transferred to the AGCM in terms of modified fluxes of momentum and heat. Two aspects of the coupled model are investigated: whether the ocean wave fields are realistic and whether the atmospheric circulation is modified by the surface fluxes induced by the spatially and temporally varying wave field. The coupled model generates waves with mean wave height of 1 to 2 m in the Northern Hemisphere and in the tropics, and of more than 3 m in the Southern Hemisphere storm track. These compared favorably with observational data. Young wind sea, which is associated with enhanced surface fluxes, is generated in the storm track in the Southern Hemisphere, in the Northern Hemisphere subtropics and the Arabian Sea. The atmospheric circulation in the coupled experiment differs only in the Southern Ocean storm belt from the circulation in a control experiment without the wave model. The time mean meridional gradient of 500 hPa geopotential height is steepened. The high frequency variance, representative of baroclinic disturbances, is shifted poleward and is intensified at high latitudes. Young wind sea is

generated mostly in the equatorward 'frontal' area of a cyclone. The 'storm-wave interaction' hypothesis proposes that the inhomogeneous distribution of surface roughness below a cyclone accelerates the poleward movement of cyclones. At the same time the cyclones live longer, or they become more frequent. Thus, the process of generating ocean waves is probably important for weather forecasting. ESA

N93-23635# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
A HYBRID COUPLED TROPICAL ATMOSPHERE OCEAN MODEL: SENSITIVITIES AND HINDCAST SKILL
Richard Kleeman (Bureau of Meteorology, Victoria, Australia.), Mojib Latif, and Moritz Fluegel Jan. 1992 38 p
(MPIM-76; ETN-93-93760) Avail: CASI HC A03/MF A01

The behavior of a hybrid coupled model consisting of a simple atmospheric model and a tropical Pacific ocean general circulation model is examined. The atmosphere is a Gill type dynamical model forced by latent heating determined from a moisture equation. The model is shown to oscillate for suitable choices of the coupled strength and this oscillatory behavior is analyzed with a view to determining mechanisms. Evidence is presented that the phase reversal from warm to cold involves the formation of a 'dipole pattern' of opposite signed sea surface temperature between the eastern and central Pacific. The cold eastern water is then advected westward causing the termination of the 'warm event'. Central to the formation of the dipole pattern in the coupled oscillation, is the strong local oceanic response to easterly atmospheric anomalies in the eastern Pacific and weak remote response there to strong central Pacific westerlies. The model is examined for forecast skill using a large ensemble of two year hindcasts. The relationship between this skill and the mechanisms elucidated in the oscillatory case is discussed. ESA

N93-23637# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
THE JOINT NORMAL MODES OF THE COUPLED ATMOSPHERE-OCEAN SYSTEM OBSERVED FROM 1967 TO 1986
Jin-Song Xu Jan. 1992 44 p
(MPIM-78; ETN-93-93672) Avail: CASI HC A03/MF A01

Two aspects of the Principal Oscillation Pattern (POP) analysis are used to study the joint normal modes of the coupled atmosphere-ocean system from a combined dataset including both atmospheric (sea level pressure, 700 mb and 200 mb zonal wind) and oceanic (sea surface temperature, Pacific sea level and Pacific subsurface temperature) parameters. The first aspect is that the POP's can be considered as normal modes of the analyzed system. Because of the complexity of the coupled systems, a straightforward method of studying these normal modes is to estimate them from the data. The second aspect of the POP analysis is that it can be considered as a multivariate spectral analysis. The spectral types of the modes are byproducts of the POP analysis. Six joint normal modes of the coupled atmosphere-ocean system are found. For Mode 1, 2 and 3 whose spectra are white or nearly white, the atmosphere plays an important role. The associated oceanic anomalie seem to be generated by the anomalous atmospheric conditions. For the other modes which have most of their power in much longer time scales, the ocean is more actively involved. Modes 4 and 5 describe decadal time scale variations. Mode 4 is characterized by changes in Sea Surface Temperature (SST) in all three tropical oceans, and in organized convection over the west Pacific. The results gave speculation that these tropical features might excite changes in the extratropical tropospheric and oceanic circulations. Mode 5 shows global scale SST anomalies and large anomalies in the Southern Hemispheric circulation. Mode 6 is the only oscillatory normal mode found in the coupled atmospheric-ocean system, it describes the quasi-cyclic behavior of the El Nino/Southern Oscillation (ENSO) phenomenon. ESA

N93-23650# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
RELATIONSHIP OF HEIGHT GRADIENTS OF PASSIVE ATMOSPHERIC PROPERTIES TO THEIR VARIANCES: APPLICATIONS TO THE GROUND-BASED SENSING OF PROFILES
E. E. Gossard (Colorado Univ., Boulder.) Aug. 1992 29 p Sponsored by Naval Command, Control and Ocean Surveillance
(PB93-136497; NOAA-TR-ERL-448-WPL-64) Avail: CASI HC A03/MF A01

Ways of relating height profiles of mean atmospheric properties to their variances are compared. Assuming a horizontally homogeneous, time-stationary medium, all methods assert the proportionality of the variance of a property to the variance of the turbulent velocity in the medium, to the square of the height gradient of the mean, and to the inverse Vaisala-Brunt frequency squared. The paper examines the dependence of the proportionality factor on the Richardson number. Finally, the various options for retrieving humidity profiles and refractive index profiles from radar wind Profiler data are discussed, and reasons are given why a system that makes use of the acoustic backscatter as well as the radar backscatter is attractive. GRA

N93-23657# Northwest Research Associates, Inc., Bellevue, WA.
NONLINEAR GRAVITY WAVE TRANSPORT AND ITS ROLE IN THE GENERAL CIRCULATION OF THE ATMOSPHERE Final Report, 15 Apr. 1989 - 14 Apr. 1992
Timothy J. Dunkerton 14 Jun. 1992 28 p
(Contract F49620-89-C-0051)
(AD-A259659; NWRA-CR-92-R088) Avail: CASI HC A03/MF A01

Gravity waves play a significant role in the transport of momentum, heat, and constituents in the terrestrial atmosphere. Due to mean-flow shear, the gravity wave critical layer is a locus of isentropic overturning, secondary convective instability, turbulence, and mean flow acceleration. These processes were simulated numerically in a two-dimensional model, and a convective saturation hypothesis for breaking gravity waves was confirmed. The role of parameterized wave transport in the quasi-biennial oscillation, and effects of angular momentum advection by the mean meridional circulation, were also addressed. GRA

N93-23674# Westinghouse Savannah River Co., Aiken, SC.
NUMERICAL SIMULATIONS OF THE TRANSPORT AND DIFFUSION DURING THE 1991 WINTER VALIDATION STUDY ALONG THE FRONT RANGE IN COLORADO
J. D. Fast and B. L. OSteen 1992 15 p Presented at the 10th Symposium on Turbulence and Diffusion, Portland, OR, 29 Sep. - 2 Oct. 1992
(Contract DE-AC09-89SR-18035)
(DE93-002684; WSRC-MS-92-160; CONF-9209158-8) Avail: CASI HC A03/MF A01

An important aspect of the U.S. Department of Energy's Atmospheric Studies in Complex Terrain (ASCOT) program is the development and evaluation of numerical models that predict transport and diffusion of pollutants in complex terrain. Operational mesoscale modeling of the transport of pollutants in complex terrain will become increasingly practical as computational costs decrease and additional data from high-resolution remote sensing instrumentation networks become available during the 1990s. Four-dimensional data assimilation (4DDA) techniques are receiving a great deal of attention recently not only to improve the initial conditions of mesoscale forecast models, but to create high-quality four-dimensional mesoscale analysis fields that can be used as input to air-quality models. In this study, a four-dimensional data assimilation technique based on Newtonian relaxation is incorporated into the Colorado State University (CSU) Regional Atmospheric Modeling System (RAMS) and evaluated using data taken from one experiment of the 1991 ASCOT field study along the front range of the Rockies in Colorado. The main objective of this study is to compare the observed surface concentrations with those predicted by a Lagrangian particle dispersion model and to demonstrate the effect of data assimilation on the simulated plume. In contrast to previous studies in which the smallest horizontal grid spacing was 10 km (Stauffer and Seaman, 1991) and 8 km (Yamada and Hermi, 1991), data assimilation is applied in this study to domains with a horizontal grid spacing as small as 1 km. DOE

N93-23733*# National Aeronautics and Space Administration, Washington, DC.
EARTH'S MYSTERIOUS ATMOSPHERE. ATLAS 1: TEACHERS GUIDE WITH ACTIVITIES
Nov. 1991 73 p
(NASA-EP-282; NAS 1.19:282) Avail: CASI HC A04/MF A01

One of our mission's primary goals is to better understand the physics and chemistry of our atmosphere, the thin envelope of air that provides for human life and shields us from the harshness of space. The Space Shuttle Atlantis will carry the ATLAS 1 science instruments 296 km above Earth, so that they can look down into and through the various layers of

the atmosphere. Five solar radiometers will precisely measure the amount of energy the Sun injects into Earth's environment. The chemistry at different altitudes will be measured very accurately by five other instruments called spectrometers. Much of our time in the cockpit of Atlantis will be devoted to two very exciting instruments that measure the auroras and the atmosphere's electrical characteristics. Finally, our ultraviolet telescope will probe the secrets of fascinating celestial objects. This Teacher's Guide is designed as a detective story to help you appreciate some of the many questions currently studied by scientists around the world. Many complex factors affect our atmosphere today, possibly even changing the course of global climate. All of us who live on Earth must recognize that we play an ever-growing role in causing some of these changes. We must solve this great atmospheric mystery if we are to understand all these changes and know what to do about them. Author (revised)

N93-23857# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
NORMAL MODES OF THE ATMOSPHERE AS ESTIMATED BY PRINCIPAL OSCILLATION PATTERNS AND DERIVED FROM QUASI-GEOSTROPHIC THEORY
Reiner Schnur, Gerhard Schmitz (Rostock Univ., German D.R..), Norbert Grieger (Rostock Univ., German D.R..), and Hans vonStorch Mar. 1992 46 p
(MPIM-81; ETN-93-93675) Avail: CASI HC A03/MF A01

The Principal Oscillation Pattern (POP) analysis is a technique to empirically identify time dependent spatial patterns in a multivariate time series of geophysical or other data. In order to investigate medium scale and synoptic waves in the atmosphere it was applied to tropospheric geopotential height fields. The data was subjected to zonal Fourier decomposition and to time filtering so that variations with periods between 3 and 25 days were retained. Analyses were performed separately for each zonal wavenumber 5 to 9 on both hemispheres in Winter. The most significant POP's are very similar in time and spatial structure to the most unstable waves in the stability analysis. They describe the linear growth phase of baroclinic, unstable waves which propagate eastward with periods of 3 to 7 days. Since the POP's are purely derived from observations the results indicate the appropriateness of the assumptions usually made in linear stability analysis of zonally symmetric flows to explain high frequency atmospheric fluctuations. The POP Analysis reveals patterns which are not found in the linear stability analysis. These can possibly be attributed to the nonlinear decay phase of baroclinic waves. Eliassen-Palm cross sections help to clarify the interpretation of the POP's in terms of the life cycle of nonlinear baroclinic waves. ESA

N93-23858# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
ON REGIONAL SURFACE FLUXES OVER PARTLY FORESTED AREAS
Martin Claussen and Wim Klaassen (Groningen Rijksuniv., Netherlands.) May 1992 15 p
(MPIM-82; ETN-93-93676) Avail: CASI HC A03/MF A01

Neglection of air flow into and from the edges of tall vegetation appears to result in a severe understanding of local advection. In a regional scale, this 'edge effect' leads to an increase of momentum flux, whereas the sign of change varies for the heat fluxes. A heuristic model showing that the edge effect can be attributed to form drag at tall vegetation is presented. It is hypothesized that the regional momentum flux should be evaluated from an effective roughness length which implicitely accounts for the form drag, whereas the regional heat fluxes should be determined from local surface parameters. The fair agreement of results from a one dimensional model, which is based on the above reasoning, and a two dimensional, multilayer model of vegetation, supports the hypothesis. ESA

N93-23859# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
ON THE COLD START PROBLEM IN TRANSIENT SIMULATIONS WITH COUPLED ATMOSPHERE-OCEAN MODELS
Klaus Hasselmann, Robert Sausen (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany.), Ernst Maier-Reimer, and Reinhard Voss (Hamburg Univ., Germany.) May 1992 27 p Sponsored by Commission of European Communities; Max-Plank-Geselschaft; Frie und Hansestadt Hamburg; and DLR
(MPIM-83; ETN-93-93677) Avail: CASI HC A03/MF A01

Using linear response theory, a general expression for the cold start error in transient numerical experiments with coupled atmosphere-ocean general circulation models is derived. The theory is applied to the Hamburg CO2 scenario simulations. An attempt to estimate the global mean temperature response function of the coupled model from the response of the model to a CO2 doubling was unsuccessful because of the nonlinearity of the system. However, an alternative derivation based on the transient simulation itself yielded a cold start error which was able to explain the initial retardation of the Hamburg global warming curve relative to the IPCC (Intergovernmental Panel on Climate Change) results obtained with a simple box diffusion-upwelling model. In the case of the sea level the behavior of the model is apparently more ideal. The cold start error estimations based on a CO2 doubling experiment and on an experiment with gradually increasing CO2 (Scenario A) are very similar and explain about two thirds of the coupled model retardation relative to the IPCC results. ESA

N93-23965 Oxford Univ. (England).
THE QUASI-BIENNIAL OSCILLATION IN THE MIDDLE ATMOSPHERE Ph.D. Thesis
Sarah Louise Ruth 1991 192 p
Avail: Univ. Microfilms Order No. BRD-97302

The quasi-biennial oscillation of equatorial zonal winds has a significant influence on other quantities such as temperature and the distribution of various chemical constituents at all latitudes throughout the stratosphere. The mechanisms through which the influence of the equatorial QBO spreads beyond the tropics are not well-understood. In this thesis, the current knowledge of the QBO is reviewed and attempts to address some of the remaining questions are described. The RAL/Cambridge two-dimensional model with an idealized parameterization of the equatorial QBO has been shown to reproduce many of the significant features of the observed tropical and extratropical QBO; however, the period of the modelled QBO tended to be unrealistically regular. In this study an alternative approach is described in which the modelled equatorial zonal wind is relaxed towards observed values. This produces a more realistic period and allows the modelled QBO in particular years to be compared with observations. In the results presented here there is particular emphasis on the signal in column ozone. There is good agreement with observations: the model captures the effects of the QBO over a range of latitudes and heights, including the important interaction with the annual cycle and by examining the modelled signal in mid latitudes it is also possible to infer accurately the relative severity of the Antarctic spring ozone depletion during most years. The two-dimensional model was also used to investigate aspects of the QBO in Antarctic ozone. The signal was found to be partly dynamical in origin, but appears to arise primarily out of a quasi-biennial modulation of chemical or thermal conditions within the vortex region. It was not possible to make a detailed study of these factors with the current model. In the final part of this thesis an analysis of the QBO signal in SAMS temperature data is presented. The annual and semi-annual cycles in these measurements were also studied and useful results obtained. Dissert. Abstr.

N93-23978# Pacific Northwest Lab., Richland, WA.
LIGHT EXTINCTION IN THE ATMOSPHERE
N. Laulainen Jun. 1992 34 p Presented at the IAU/ICSU/UNESCO Exposition in the Adverse Environment Impact on Astronomy, Paris, France, 30 Jun. - 2 Jul. 1992
(Contract DE-AC06-76RL-01830)
(DE93-005034; PNL-SA-21022; CONF-9206325-1) Avail: CASI HC A03/MF A01

Atmospheric aerosol particles originating from natural sources, such as volcanos and sulfur-bearing gas emissions from the oceans, and from human sources, such as sulfur emissions from fossil fuel combustion and biomass burning, strongly affect visual air quality and are suspected to significantly affect radiative climate forcing of the planet. During the daytime, aerosols obscure scenic vistas, while at night they diminish our ability to observe stellar objects. Scattering of light is the main means by which aerosols attenuate and redistribute light in the atmosphere and by which aerosols can alter and reduce visibility and potentially modify the energy balance of the planet. Trends and seasonal variability of atmospheric aerosol loading, such as column-integrated light extinction or optical depth, and how they may affect potential climate change have been difficult to quantify because there have been few observations made of important aerosol optical parameters, such as optical depth, over the globe and over time and often these are of uneven quality. To address questions related to possible climate change, there is a pressing need to acquire more high-quality

aerosol optical depth data. Extensive deployment of improved solar radiometers over the next few years will provide higher-quality extinction data over a wider variety of locations worldwide. An often overlooked source of turbidity data, however, is available from astronomical observations, particularly stellar photoelectric photometry observations. With the exception of the Project ASTRA articles published almost 20 years ago, few of these data ever appear in the published literature. This paper will review the current status of atmospheric extinction observations, as highlighted by the ASTRA work and augmented by more recent solar radiometry measurements. DOE

N93-23996# Hawaii Univ., Honolulu. Oceanographic Engineering Lab.
MICROTOPOGRAPHY OF MANGANESE CRUSTS Final Report, 1 Oct. 1989 - 30 Sep. 1991
Charles L. Morgan 1991 11 p Sponsored by Bureau of Mines, Washington, DC
(Grants DI-BM-G1185128; DI-BM-G1195128)
(PB93-120830) Avail: CASI HC A03/MF A01

Quantitative examination of the seafloor surface roughness will be necessary for any design of equipment intended for use in collecting surface deposits such as cobalt-rich manganese crusts or nodules. Furthermore, it is an essential prerequisite to the confident interpretation of returns from high frequency side-scan and other acoustic systems. The objectives of the project were to develop the capability at the University of Hawaii of generating high resolution (less than 1 cm horizontal and vertical) topographic models of the seafloor from 35 mm stereo photographs; to produce such models from existing photographs of cobalt-rich manganese crust deposits; and to optimize the configuration of the existing Hawaii Undersea Research Laboratory (HURL) camera system for stereo photograph collection and correlation of acoustic data with the photographic ground-truth. These tasks were accomplished and have also led to the development of a follow-on project (MMTC/OBD Project 1512) dedicated to the simultaneous acquisition of both optical and side-scan acoustic data for future accurate determination of seabed microtopography. Author

N93-24006# Rizzo (Paul C.) Associates, Monroeville, PA.
HIGH RESOLUTION SHEAR WAVE REFLECTION SURVEYING FOR HYDROGEOLOGICAL INVESTIGATIONS
W. J. Johnson and J. C. Clark Aug. 1992 94 p
(Contract W-31-109-eng-38)
(DE93-004732; DOE/CH-9211) Avail: CASI HC A05/MF A01

The high resolution S-wave method has been developed to be a powerful tool in mapping subsurface lithology and in conducting groundwater investigations. The research has demonstrated that the resolution obtainable using S-waves in a Coastal Plain environment is more than double than that obtained using conventional reflection, which already offers a higher resolution than any other surface method. Where the mapping of thin clay layers functioning as aquitards or thin sand layers functioning as aquifers are critical to the understanding of groundwater flow, S-wave reflections offer unparalleled possibilities for nondestructive exploration. The field experiment at Cooke Crossroads, South Carolina enabled the detection and mapping of beds in the thickness range of one to three feet. The S-wave reflection technique, in combination with conventional P-wave reflection, has potential to directly detect confined and unconfined aquifers. This is a breakthrough technology that still requires additional research before it can be applied on a commercial basis. Aquifer systems were interpreted from the test data at Cooke Crossroads consistent with theoretical model. Additional research is need in assessing the theoretical response of P- and S-waves to subsurface interfaces within unconsolidated sediments of varying moisture content and lithology. More theoretical modeling and in situ testing are needed to bring our knowledge of these phenomena to the level that oil and gas researchers have done for fluids in sandstones. DOE

N93-24018# Clauser (John F.) and Associates, Walnut Creek, CA.
COMMERCIALIZATION OF ATOM INTERFEROMETERS FOR BOREHOLE GRAVITY GRADIOMETRY
John F. Clauser 30 Jan. 1993 5 p
(Contract DE-FG49-92CE-15500)
(DE93-006889; DOE/CE-15500/T1) Avail: CASI HC A01/MF A01

We perform a mathematical analysis of the tomography inversion problem for various configurations of a borehole gravity gradiometer. Our simulations typically call for logging a hole for about 4km of depth. Within the limits imposed by our presumed detector sensitivity, the device appears to be capable of measuring the 0.1 g/cu cm density in all rings to about 10 percent accuracy, with the rings extending out to about 500 meters from the hole. At this range, the vertical resolution has dropped to about 50m. Closer to the hole, the resolution improves so that we can determine the density in each of about 400 rings. We anticipate that this most important task (No. 1) will be complete within the next quarter. DOE

N93-24060# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
ON COLLIDING PLANE GRAVITATIONAL WAVES COUPLED WITH FLUID MOTIONS
J. B. Griffiths and P. C. Ashby Jun. 1992 8 p Sponsored by United Kingdom Science and Engineering Research Council
(MATHS-Rept-A-161; ETN-93-93557) Avail: CASI HC A02/MF A01

The generation of stiff fluid or scalar field solutions from vacuum solutions in the colliding plane wave problem is considered. Two different potentials which give rise to such solutions are described and an indication as to how large families of new solutions can be obtained is given. ESA

N93-24079# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
ON THE PROPAGATION OF A GRAVITATIONAL WAVE IN A STIFF PERFECT FLUID
J. B. Griffiths Sep. 1992 14 p
(MATHS-Rept-A-178; ETN-93-93561) Avail: CASI HC A03/MF A01

The propagation of a gravitational wave in a stiff fluid is considered. The background region ahead of the wave is taken to be conformally flat. The gravitational wave is taken to have constant linear polarization. By obtaining a class of exact solutions in the form of a power series, it is shown that as the wave propagates into the fluid it is partially reflected and interaction terms also appear in the Weyl tensor. On interaction with the wave, the fluid begins to accelerate and shear, and its expansion is also modified. ESA

N93-24080# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
THE COLLISION OF GRAVITATIONAL WAVES IN A STIFF PERFECT FLUID
J. B. Griffiths Sep. 1992 9 p
(MATHS-Rept-A-179; ETN-93-93562) Avail: CASI HC A02/MF A01

Exact solutions which describe the collision and interaction of gravitational waves in a stiff fluid medium are presented. The background region ahead of each wave is conformally flat, and the gravitational waves have constant and aligned polarization. Behind the waves the gravitational field is algebraically general, reflecting the fact that each wave is backscattered as it propagates through the fluid. ESA

N93-24081# Norwegian Defence Research Establishment, Kjeller.
INTERPRETATION OF MEASUREMENTS FROM THE QUADRUPOLE PROBE ON THE NEED-2 ROCKET
Knut Svenes and Jan Troeim 19 May 1992 27 p
(FFI-92/7016; ETN-93-93568) Avail: CASI HC A03/MF A01

The NEED 2 rocket was launched from Andoya (Norway) 11 Oct. 1990, and the flight was carried through during a geomagnetically moderate period. The analysis of the data set obtained by the quadrupole probe is presented. An interpretation of the various measurements and an assessment of the instrument performance are given. ESA

N93-24082 Colorado State Univ., Fort Collins.
CHAOS THEORY AND ITS APPLICATION IN THE ATMOSPHERE Ph.D. Thesis
Xubin Zeng 1992 192 p
Avail: Univ. Microfilms Order No. DA9303910

Chaos theory, including the bifurcation and route to turbulence, and the characterization of chaos, is thoroughly reviewed. A practical method without adjustable free parameters was developed to compute the Lyapunov-exponent spectrum from short time series of low precision. The application of chaos is divided into three categories: observational data analysis, new ideas or insights inspired by chaos, and numerical model output analysis. Corresponding with these categories, three subjects are

studied. First, the fractal dimension, Lyapunov-exponent spectrum, Kolmogorov entropy, and predictability are quantitatively evaluated from observed daily data of surface temperature and pressure over regions of different climate signal/noise ratios. No low-dimensional attractors can be obtained from these observational data. The error-doubling time is 2 to 8 days at different locations. Second, chaos in daisyworld, which is an idealized ecosystem/atmosphere interactive model, was studied. Periodic and chaotic states are found when the parameter controlling the feedback between biota and their environment is changed. This raises important questions regarding the validity and interpretation of the Gaia hypothesis. Finally, two-and three-dimensional mesoscale and large-eddy simulations are performed to study in detail the initial adjustment process and error growth dynamics of surface thermally-induced circulations, including the sensitivity to initial and boundary conditions as well as to model parameters. The predictability as a function of the size of surface heat patches under calm synoptic wind is quantitatively evaluated. Two-and three-dimensional simulations yield close or similar results regarding the predictability. The predictability and the coherent circulations modulated by the surface inhomogeneities are also studied by computing the autocorrelations and power spectra. A low (less than 5)-dimensional attractor is obtained from the model output. Possible physical processes related to these low dimensions are discussed. Dissert. Abstr.

N93-24086# Colorado Univ., Boulder. Dept. of Physics.
A SYSTEMATIC STUDY OF THE EFFECTS OF CRUST AND UPPER MANTLE STRUCTURE ON REGIONAL SEISMOGRAMS Report No. 1
Danny J. Harvey 1 Jun. 1992 33 p
(Contract F19628-90-K-0050)
(AD-A260231; PL-TR-92-2138) Avail: CASI HC A03/MF A01

As part of a broader effort to invert for Eurasian crust an upper mantle structure, a study was undertaken to-investigate the effects of structural model variations on regional synthetic seismograms. The intent is to produce regional synthetic seismograms that approximately match the observed data so that the inferred structural models can be used as starting points in a formal inversion procedure. Using laterally homogeneous structural models, the velocity-depth functions were systematically varied down to about 500 km depth and compared synthetic seismograms to data out to about 2000 km distance. Differential seismograms were used to infer relationships between structural parameters and the resulting seismograms. By using standard Eurasian crust and upper mantle structural models and introducing velocity randomization, it is possible to produce synthetic seismograms that show all of the regional phases complete with attendant coda. However, the synthetic seismograms show energetic P(sub g) and S(sub n) phases at distances above 1000 km that are often not present in the data. The S(sub n) phase can be reduced by suitable upper mantle velocity profiles. The reduction of P(sub g) in the synthetics is more difficult which indicates that lateral scattering may be reducing P(sub g) amplitudes without adversely affecting L(sub g). GRA

N93-24090# Norwegian Defence Research Establishment, Kjeller.
VISUALIZATION OF GRAVITY WAVE DATA BY IRIS EXPLORER (A COMPUTER PROGRAM)
Oeyvind Andreassen and Joe Isler 17 Jul. 1992 26 p Original contains color illustrations
(FFI-92/7022; ETN-93-93570) Avail: CASI HC A03/MF A01

Using the Iris Explorer system, running on Silicon Graphics workstations, Explorer modules for processing and extracting features from gravity wave data were custom built. The model, the Iris Explorer system, and the modules, are described. The system is applied to data from three dimensional gravity wave breaking simulations carried out on a Cray Y-MP supercomputer. ESA

N93-24106 Washington Univ., Seattle.
NONMIGRATING DIURNAL TIDES IN THE EQUATORIAL MIDDLE ATMOSPHERE Ph.D. Thesis
Ruth S. Lieberman 1992 225 p
Avail: Univ. Microfilms Order No. DA9239465

Data from the Nimbus 7 Limb Infrared Monitor of the Stratosphere (LIMS) are used to analyze the diurnal tides in the middle atmosphere. A novel aspect of this study is the emphasis on the relative importance of the nonmigrating components. These modes display a high degree of temporal variability during the LIMS observing period, and contribute substantially to the diurnal signal in wind and temperature. Their observed vertical phase variations are variable; however there is evidence for upward energy propagation. It has long been hypothesized that nonmigrating tides are driven by the diurnally-varying zonally asymmetric tropospheric heating constituents. This premise is examined by employing a linear tidal model to simulate the response of the atmosphere to realistic tidal drives. These quantities are calculated from the NCAR Community Climate Model. The large-scale CCM2 diurnal surface pressure, OLR and hydrology are well simulated under July and January conditions. The CCM2 diurnal fields of short-wave radiative, convective and diffusive PBL hearing are used as input to a linear tidal model with Newtonian cooling. This model successfully reproduces many observed features of the migrating and nonmigrating diurnal surface pressure tides at low latitudes. In the middle atmosphere, tropospheric solar heating is the dominant source of the migrating tide. The zonal means and eastward migrating wavenumber one components are also associated with radiative heating. The eastward migrating wavenumber three pattern is strongly linked to the dry and moist convective heating as well. The observed eastward migrating tides are harder to simulate, due in part to the failure of the linear model to incorporate the dissipative effects to which they are prone. Dissert. Abstr.

N93-24148*# National Aeronautics and Space Administration, Washington, DC.
ATMOSPHERIC DETECTIVES: ATLAS 2 TEACHER'S GUIDE WITH ACTIVITIES. FOR USE WITH MIDDLE-SCHOOL STUDENTS
Nov. 1992 26 p
(NASA-EP-285; NAS 1.19:285) Avail: CASI HC A03/MF A01

Can you imagine doing a science project in space? This is the challenging and exciting situation that researchers experience in Spacelab, the laboratory carried inside the Shuttle. Here, hundreds of kilometers above Earth's surface, the crews of the ATLAS missions scan, probe, and measure concentrations of chemicals and water vapor in Earth's protective bubble. So far, one ATLAS crew has rocketed into the atmosphere, watching many sunrises and sunsets come and go while activating delicate instruments and conducting experiments that monitor the complicated interactions between the Sun, the atmosphere, and Earth. We, the crew of ATLAS 2, will continue this important work aboard the Space Shuttle. Together, we will gather data that will be compared with information from satellites, balloons, and instruments on the ground. As part of the National Aeronautics and Space Administration's (NASA's) contribution to Mission to Planet Earth, ATLAS 2 will help develop a thorough picture of the Sun's output, its interaction with the atmosphere, and the well-being of Earth's middle atmosphere. Because the health of the atmosphere is of vital importance to all Earth's inhabitants, everyone should be part of this investigation. You can be active participants in exciting and vital activities: recycling and practicing other conservation methods and gathering information to learn more about how you can keep our atmosphere healthy now, as students, and in the future as informed citizens, scientists, technicians, and mathematicians. Author

N93-24183 Rice Univ., Houston, TX.
A STUDY OF HIGH-LATITUDE AURORAL ARCS USING RADAR, OPTICAL, AND IN SITU TECHNIQUES Ph.D. Thesis
Loretta A. Weiss 1992 135 p
Avail: Univ. Microfilms Order No. DA9234446

Two experimental campaigns designed to study high-latitude auroral arcs have been conducted in Sonde Stromfjord, Greenland. The Polar Acceleration Regions and Convection Study (Polar ARCS) on February 26, 1987, consisted of a coordinated set of ground-based and sounding rocket measurements of a weak, sun-aligned arc within tne duskside polar cap, while the Rodeo 1 and 2 experiments, conducted during December, 1988 and October, 1989, involved uniquely coordinated optical and radar measurements of high-latitude arcs occurring at the poleward boundary of the auroral oval. Analysis of the large-scale Polar ARCS data indicate anti-sunward convection in the region between the dusk-side auroral oval and the sun-aligned arc. This convection signature is consistent with either a model in which the sun-aligned arcs formed on open field lines over the polar cap or on closed field lines threading an expanded low-latitude boundary layer, but not a model in which the polar cap arc field lines map to an expanded plasma sheet. Electron measurements indicate that the rocket passed through three narrow (less than or equal to 20 km) regions of low-energy (less than or equal to 100 eV) electron precipitation. An

electrodynamic analysis has shown the electric and magnetic field perturbations in these regions to be well correlated and associated with small-scale upward and downward field-aligned currents of 1-2 micro-A/sq m. The Rodeo measurements have been used to examine the aeronomic and electrodynamic characteristics of two optically stable arcs occurring at different magnetic local times and exhibiting different relationships to the polar cap/convection reversal boundary. The first case study is associated with a reversal from antisunward to sunward flow and also the boundary between open and closed field lines. In contrast, the second case study involved an arc with a much greater average precipitation energy and a significant cross-arc flow, evidenced by the radar measurements as well as the convective motion of a polar cap patch directly across the arc. Owing to the relative motion between the F-layer plasma and the arc precipitation, this arc is interpreted as forming across the nightside merging gap on field lines which map to a region of stable reconnection in the tail. Dissert. Abstr.

N93-24214# Geological Survey, Denver, CO.
ASSESSMENT OF REGIONAL EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH
Paula L. Gori, ed. and Walter W. Hays, ed. 1992 349 p Prepared in cooperation with Utah Geological and Mineral Survey, Salt Lake City, Utah State Univ., Logan, and Utah Univ., Salt Lake City
(PB93-115657; USGS-PP-1500-A-J; LC-90-26385) Avail: CASI HC A15/MF A03

The contents are as follows: Paleoseismology of the Wasatch Fault Zone--A Summary of Recent Investigations, Interpretations, and Conclusions; Persistent and Nonpersistent Segmentation of the Wasatch Fault Zone, Utah--Statistical Analysis for Evaluation of Seismic Hazard; Subsurface Geology Along the Wasatch Front; Observational Seismology and the Evaluation of Earthquake Hazards and Risk in the Wasatch Front Area, Utah; Superimposed Late Cenozoic, Mesozoic, and Possible Proterozoic Deformation Along the Wasatch Fault Zone in Central Utah; Neotectonic Framework of the Central Sevier Valley Area, Utah, and Its Relationship to Seismicity; Neotectonics of the Hansel Valley-Pocatello Valley Corridor, Northern Utah and Southern Idaho; Structure of the Salt Lake Segment, Wasatch Normal Fault Zone--Implications for Rupture Propagation During Normal Faulting; Late Quaternary Displacement on the Morgan Fault, a Back Valley Fault in the Wasatch Range of Northeastern Utah; and Late Quaternary History of the James Peak Fault, Southernmost Cache Valley, North-Central Utah. GRA

N93-24253# Teledyne Geotechnical, Alexandria, VA. Alexandria Lab.
DEVELOP AN X-WINDOWS TOOL TO COMPUTE GAUSSIAN BEAM SYNTHETIC SEISMOGRAMS Semiannual Report No. 1, 23 Aug. 1991 - 4 Apr. 1992
J. P. Davis and Ivan H. Henson 4 Apr. 1992 18 p
(Contract F29601-91-C-DB04; ARPA Order 6731)
(AD-A260034; TGAL-92-03) Avail: CASI HC A03/MF A01

Two principal topics are discussed: an introduction in which the functional flow and the basic architecture of a prototype system for computing synthetic seismograms using the Gaussian Beam method are described, and a second section in which progress toward implementing that design is outlined. To maximize functionality, the design integrates as much as possible software already developed under the NMRD initiative: code for handling database transactions, inter-process communication, and graphical display of seismograms are assumed to exist. The system has two modules. The first provides X-Windows graphics to allow the user to construct and manipulate two-dimensional earth models, and also to trace the propagation of seismic waves through those models. The second module computes synthetic seismograms and/or calculates traveltimes for models constructed with the first. It has no graphical component. The raytracing capabilities of the program were found to be very fast, owing in part to the way the velocity model was parameterized. Several figures demonstrating model construction and raytracing are included. GRA

N93-24254# Princeton Scientific Instruments, Monmouth Junction, NJ.
STUDY OF HIGH SPATIAL RESOLUTION NARROW SPECTRAL BAND ULTRAVIOLET IMAGES OF THE EARTH'S ATMOSPHERE Final Report, Feb. 1990 - Sep. 1992
John L. Lowrance 30 Sep. 1992 32 p
(Contract F19628-90-C-0052)
(AD-A260035; PSI-TM-9201; PL-TR-92-2239; AD-E201358) Avail: CASI HC A03/MF A01

The primary objective was the development of an ultraviolet sensitive television type camera that would be suitable for use on a polar orbiting satellite to obtain high spatial resolution narrow spectral band images of the earth's atmosphere in the 125 to 320 nm wavelength region. An ultraviolet camera with high spatial resolution was designed for the AURA payload. After the first year, emphasis shifted to ground based UV observations when funding for a space borne UV Imager was not foreseen in the near future. The existing ground based UV Imager was upgraded and used to observe rocket launches and e-beam excitation of the ionosphere. In 1992, a Princeton Scientific Instruments Digital CCD Camera System was modified and used successfully for ionospheric observations as a part of the Combined Release and Radiation Effects (CRRES) program, a multi-instrument program to observe sounding rocket releases of barium into the ionosphere. GRA

N93-24255# Oak Ridge National Lab., TN. Environmental Sciences Div.
DESIGN AND IMPLEMENTATION OF A COMPUTER BASED SITE OPERATIONS LOG FOR THE ARM PROGRAM
Joyce L. Tichler (Brookhaven National Lab., Upton, NY.), H. J. Bernstein (Bernstein and Sons, Bellport, NY.), S. F. Bobrowski (Pacific Northwest Lab., Richland, WA.), R. B. Melton (Pacific Northwest Lab., Richland, WA.), A. P. Campbell (Argonne National Lab., IL.), Donna M. Edwards (Sandia National Labs., Livermore, CA.), Paul Kanciruk, and Paul T. Singley 1992 6 p Presented at the Scientific Data Management Workshop '92, Salt Lake City, UT, 3-5 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-002834; CONF-9211115-1) Avail: CASI HC A02/MF A01

The Atmospheric Radiation Measurement (ARM) Program is a Department of Energy (DOE) research effort to reduce the uncertainties found in general circulation and other models due to the effects of clouds and solar radiation. ARM will provide an experimental testbed for the study of important atmospheric effects, particularly cloud and radiative processes, and testing of parameterizations of the processes for use in atmospheric models. The design of the testbed known as the Clouds and Radiation Testbed (CART), calls for five, long-term field data collection sites. The first site, located in the Southern Great Plains (SGP) in Lamont, OK began operation in the spring of 1992. The CART Data Environment (CDE) is the element of the testbed which acquires the basic observations from the instruments and processes them to meet the ARM requirements. A formal design was used to develop a description of the logical requirements for the CDE. This paper discusses the design and prototype implementation of a part of the CDE known as the site operations log, which records metadata defining the environment within which the data produced by the instruments is collected. DOE

N93-24296 California Univ., Los Angeles.
STRUCTURE AND DYNAMICS OF THE MAGNETOPAUSE Ph.D. Thesis
Zhi Wang 1992 269 p
Avail: Univ. Microfilms Order No. DA9303493

This thesis addresses several topics concerning the structure and dynamics of the magnetopause. These topics include the role of the magnetopause in global convection, the Kelvin-Helmholtz (K-H) instability, which accounts for momentum transport at the magnetopause, the formation of flux ropes by the tearing and twisting modes and particle diffusion across the magnetopause resulting from the destruction of magnetic surfaces. We first establish an analytic electric field model for an open magnetosphere and introduce a magnetopause to control the reconnection rate and momentum transport. A realistic magnetospheric configuration is realized by 'stretch transformation'. The role of magnetic nulls in the electric field is approached with a technique for direct calculation of electric fields along field lines. Results indicate that electric fields associated with A-type or B-type nulls are generally singular. We then consider kinetic effects on the K-H instability. Contrary to the logical assumption that Landau damping damps the instability, it can instead enhance the growth and increase the spatial extent of the instability because the heating of resonance particles enhances the pressure perturbation. We use a gravitational analogy to determine the effect of curvature on K-H instability and find that the critical Richardson number for stability increases from 1/4 for incompressible fluids to 1/2 for compressible fluids. The flux rope, which accounts for flux

transfer events (FTE), can be formed by a tearing or twisting mode. The tearing mode is self excited by the free energy associated with the magnetic configuration, while the twisting mode must be externally driven. The shear flow generates the twisting mode and reduces the growth rate of the tearing mode. The flux ropes resulting from the twisting mode closely resemble FTE's which have a longer pitch length than that from tearing mode. Particle diffusion across the magnetopause is addressed by considering the destruction of magnetic surfaces. The diffusion coefficient reaches 10(exp 9) m(exp 2)/s, which is critical for magnetopause boundary layer formation. The presence of regular magnetic surfaces at the edge of the current layer may account for the sharp transition that is often observed at the magnetopause. Dissert. Abstr.

N93-24301# Computational Physics, Inc., Fairfax, VA.
PRECIPITATING AURORAL ELECTRON FLUX CHARACTERISTICS BASED ON UV DATA OBTAINED BY THE AIRS EXPERIMENT ONBOARD THE POLAR BEAR SATELLITE Final Report, Aug. 1988 - Jul. 1991
D. J. Strickland and R. J. Cox Mar. 1992 72 p
(Contract F19628-88-C-0113)
(AD-A260015; AD-E201368; PL-TR-92-2073) Avail: CASI HC A04/MF A01

The AIRS instrument on satellite Polar BEAR is the first to obtain narrow band UV images for more than one band at a time. This provides the opportunity to do serious quantitative analysis of the data in terms of composition and the energy sources producing the emission (aurora and dayglow). Analysis of auroral imaging data from two passes will be presented. On one of these, simultaneous images were obtained at 1356 A (OI 1356 A plus N sub 2 LBH), 1596 A (LBH), and 3914 A (N2(+) 1N). On the other, the observed bands were centered at 1304 A (OI 1304 A), 1544 A (LBH), and 3914 A. Variations in data ratios among the three bands for either pass exceeded a factor of three over the portion of the auroral oval seen within the images. The possible causes of these variations are changes in the hardness of the precipitating particle spectrum (here the particles are assumed to be electrons), changes in the abundance of O relative to N2, changes in the albedo at 3914 A, and statistical fluctuations where signals were low. To interpret the data, yields (Rayleighs/(erg cm(exp -2)s(exp -1))) and yield ratios appropriate to the band centers and their widths were calculated versus hardness of the precipitating electron spectrum. The calculations used MSIS model atmospheres with O density scalings of 1.0 and 0.5. The input parameters were appropriate to the times at which the data were collected to the regions observed. Incident electron spectra were characterized by modified Gaussian and Maxwellian energy distributions defined in terms of characteristic energy E sub o (in keV) and energy flux Q (in ergs cm(-2)s(-1)). GRA

N93-24322# Boston Univ., MA. Center for Space Physics.
THE EFFECTS OF MAGNETIC STORM PHASES ON F-LAYER IRREGULARITIES FROM AURORAL TO EQUATORIAL LATITUDES Quarterly Report, 1 Sep. - 31 Dec. 1992
Jules Aarons and Michael Mendillo 1992 4 p
(Contract N00014-89-J-1754)
(AD-A259943) Avail: CASI HC A01/MF A01

The review of equatorial data relative to F-layer irregularities continued during this period with an emphasis in this quarter on determining the effects of localized effects on the generation of F-region irregularities. The study compares initially for one month TEC and scintillation data for Manila, the Philippines, Palehau, Hawaii, Tepei, Taiwan, and Osan, Korea all in the Pacific Sector. We are working on airglow depletion data taken in Brazil over a span of years which include years of both high and low solar flux. GRA

N93-24418# California Univ., Berkeley.
HORIZONTAL STRESS IN-SITU BY CONE PENETROMETERS AND RELATED STUDIES Final Report, 15 Oct. 1987 - 30 Sep. 1992
James K. Mitchell 20 Nov. 1992 10 p
(Contract DAAL03-88-K-0001)
(AD-A260503; ARO-24381.6-GS) Avail: CASI HC A02/MF A01

The primary objective of this project was to develop a reliable means for measurement or estimation of the in-situ geostatic lateral stress from the results of cone penetration and/or other in-situ tests. The research included analytical studies, laboratory tests on several sands, and field tests. There were two related studies: one on the causes of the aging sands and the effects of aging on properties, and the other on direct prediction of liquefaction resistance using cone penetration test measurements. The detailed research results are contained in five Ph.D. dissertations that were completed as a part of this project. GRA

N93-24424# Spectral Sciences, Inc., Burlington, MA.
ANALYSIS OF H2O INFRARED RADIANCE MEASURED DURING THE ELC-1 ROCKET EXPERIMENT Scientific Report No. 1
P. De and S. M. Adler-Golden 15 May 1992 26 p
(Contract F19628-91-C-0083)
(AD-A259986; AD-E201313; SSI-TR-213; PL-TR-92-2136) Avail: CASI HC A03/MF A01

This report presents an analysis of selected long-wavelength infrared (LWIR) limb radiance data measured in the ELC-1 radiometer experiment, launched on October 25, 1983, from the White Sands Missile Range, NM at local time 0426 hrs. From the CO2 nu(sub 2) band emission, information on the mesospheric profile and the radiometer absolute calibration is extracted. The results are combined with a measurement of water vapor rotational emission in the 23-29 micrometers region to derive a water vapor profile, accurate to within around a factor-of-two range, for 55 km - 85 km altitudes. The ELC-1 results are consistent with previous mid-latitude measurements, made by microwave and solar IR absorption techniques, during fall or early winter months, and are of comparable or better accuracy. These results demonstrate the feasibility of global long-range sensing of water vapor in the mesosphere from rotational emission data obtained in satellite experiments, including the CIRRIS-1A experiment flown on the Space Shuttle STS-39 in April, 1991. GRA

N93-24440# Science Applications, Inc., San Diego, CA.
TEST AND EVALUATION OF NEURAL NETWORK APPLICATIONS FOR SEISMIC SIGNAL DISCRIMINATION Final Report, 1 Sep. 1990 - 31 Aug. 1992
Gagan B. Patnaik, Thomas J. Sereno, Jr., and Richard D. Jenkins 28 Sep. 1992 62 p
(Contract F19628-90-C-0156)
(AD-A260030; AD-E201342; SAIC-92/1191; PL-TR-92-2218-V-2) Avail: CASI HC A04/MF A01

This study describes the operational test and evaluation of two neural network applications that were integrated into the Intelligent Monitoring System (IMS) for automated processing and interpretation of regional seismic data. Also reported is the result of a preliminary study on the application of neural networks to regional seismic event identification. The first application is for initial identification of seismic phases (P or S) recorded by 3-component stations based on polarization data and context. This neural network performed 3-6 percent better than the current rule-based system when tested on data obtained from the 3-component IRIS stations in the former Soviet Union. This resulted in an improved event bulletin which showed that the number of analyst-verified events that were missed by the automated processing decreased by more than a factor of 2 (about 10 events/week). The second operational test was conducted on the neural network developed by MIT/Lincoln Laboratory for regional final phase identification (e.g., Pn, Pg, Sn, Lg, and Rg). This neural network performed 3.3 percent better than the rule-based system in IMS station processing. However, for the final phase identifications obtained after network processing (where data from all stations are combined), the gain dropped to about 1.0 percent. It is likely that this could be regained by using the neural network phase identification confidence factors in the network processing. Finally, our preliminary study on the application of neural networks to identify regional seismic events on the basis of coda shape gave about 80 percent accuracy on data recorded at GERESS. In general, the neural network classifier utilized the coda decay rate which was lower for the earthquakes than it was for the explosions, although there was substantial overlap. GRA

N93-24485*# Johns Hopkins Univ., Baltimore, MD. Dept. of Earth and Planetary Sciences.
EMPIRICAL DETERMINATION OF THE EFFECTS OF CLOUDS ON THE EARTH'S RADIATION BUDGET OVER THE PACIFIC OCEAN Final Report, 15 Nov. 1990 - 31 Dec. 1992
Daniel Ziskin and Darrell F. Strobel 31 Dec. 1992 5 p

(Grant NAG5-1476)
(NASA-CR-192696; NAS 1.26:192696) Avail: CASI HC A01/MF A01

The main objectives of this research has been to learn how clouds interact with the Earth's Radiation Budget (ERB). This broad goal has been approached in three distinct ways. The first has been to analyze the direct effect cloud amount has on the radiative components of the ERB. The second has been to investigate the indirect effects clouds and water vapor may have on the climate as a feedback mechanism. And finally an attempt has been made to simulate the findings in a simple radiative-convective climate model. This report will summarize these three phases of the research. Derived from text

N93-24569# Environmental Protection Agency, Washington, DC. Office of Pollution, Prevention, and Toxics.
DETERMINATION OF RATES OF REACTION IN THE GAS-PHASE IN THE TROPOSPHERE. THEORY AND PRACTICE. 5. RATE OF INDIRECT PHOTOREACTION
Asa Leifer Jan. 1993 162 p
(PB93-149334; EPA/744/R-93-001) Avail: CASI HC A08/MF A02

The Atmospheric Oxidation Computer Program (AOP) for estimating the second-order rate constant k(sub OH) for the reaction of an organic chemical with hydroxyl radicals in the gas-phase in the troposphere is reviewed. AOP is being used to regulate industrial chemicals under Sections 4 and 5 of the Toxic Substances Control Act. It describes the computerization of the structure/reactivity relationships of Atkinson of the University of California/Riverside by Syracuse Research Corporation. The only input needed to operate AOP is the SMILES notation, a computerized notation of the molecular structure of the chemical. The computer program will estimate k(sub OH) and the associated half life for the reaction of organic chemicals in the atmosphere. AOP will also list an experimental value of k(sub OH) if it is available in the scientific literature. Author (revised)

N93-24615# European Space Agency, Paris (France).
SIMULATION OF THE FORMATION AND TRANSPORT OF OZONE IN THE ATMOSPHERIC BOUNDARY LAYER
Jutta Graf (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) Aug. 1992 121 p Transl. into ENGLISH of Simulation der Bildung undVerteilung von Ozon in der Atmosphaerischen Grenzschicht Original language document was announced as N91-13827
(ESA-TT-1243; DLR-FB-90-25; ETN-93-93515) Avail: CASI HC A06/MF A02; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A numerical model to simulate chemical processes in the lower atmosphere, with special emphasis on ozone formation, is introduced. It is only necessary to consider chemical reactions in the gas phase. The model is used to simulate ozone formation in an urban area due to motor car emissions. The results illustrate the strong effect of hydrocarbon emissions in ozone production. The combined effects of horizontal transport, vertical diffusion, and chemical reactions are investigated on the regional scale. High ozone levels in nonindustrial areas are mainly due to the transport of ozone precursors. Simulation of a real episode shows the importance of the initial concentrations in the resulting ozone distribution. ESA

N93-24629# National Center for Earthquake Engineering Research, Buffalo, NY.
A SEMI-EMPIRICAL ANALYSIS OF STRONG-MOTION PEAKS IN TERMS OF SEISMIC SOURCE, PROPAGATION PATH, AND LOCAL SITE CONDITIONS
M. Kamiyama, M. J. ORourke, and R. Flores-Berrones 9 Sep. 1992 155 p Sponsored by NSF and New York State Science and Technology Foundation Prepared in cooperation with Rensselaer Polytechnic Inst., Troy, NY
(Contract NSF BCS-90-25010; NEC-91029)
(PB93-150266; NCEER-92-0023) Avail: CASI HC A08/MF A02

A new type of semi-empirical expression for scaling strong-motion peaks in terms of seismic source, propagation path, and local site conditions is derived. Peak acceleration, peak velocity, and peak displacement are analyzed in a similar fashion because they are interrelated. However, emphasis is placed on the peak velocity which is a key ground motion parameter for lifeline earthquake engineering studies. With the help of seismic source theories, the semi-empirical model is derived using strong motions obtained in Japan. In the derivation, statistical considerations are used in the selection of the model itself and the model parameters. Earthquake magnitude M and hypocentral distance r are selected as independent variables and the dummy variables are introduced to identify the amplification factor due to individual local site conditions. The resulting semi-empirical expressions for the peak acceleration, velocity, and displacement are then compared with strong-motion data observed during three earthquakes in the U.S. and Mexico. Author (revised)

N93-24653*# National Aeronautics and Space Administration, Washington, DC.
THE MYSTERIOUS ATMOSPHERE OF THE EARTH. ATLAS: INSTRUCTION GUIDE WITH ACTIVITIES [LA MISTERIOSA ATMOSFERA DE LA TIERRA. ATLAS: GUIA DE INSTRUCCION CON ACTIVIDADES]
1993 25 p In SPANISH
(NASA-EP-290/03-93; NAS 1.19:290/03-93) Avail: CASI HC A03/MF A01

This teacher's guide presents lesson plans addressing various aspects of atmospheric physics and chemistry; the interactions between land, air, and sea; air pollution; and the mechanisms of climate change. The science concepts in this guide have been designed to complement the middle school curriculum. However, many activities can be used with younger or older students. CASI

N93-23546# Academy of Sciences, Potsdam (German D.R.). Geoforschungszentrum.
APPLICATIONS OF SATELLITE DATA ON SEISMIC RISK ASSESSMENT: STRAIN ANALYSIS OF FAULT LINEAMENT SYSTEMS
P. Bankwitz and E. Bankwitz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 219-224 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N93-22337# Wisconsin Univ., Madison. Dept. of Atmospheric and Oceanic Sciences.
DIAGNOSTIC DETERMINATION OF BOUNDARY-LAYER CUMULUS CLOUDS USING HAPEX AIRCRAFT DATA
Q. Zhang 1992 4 p Presented at the 10th Symposium on Turbulence and Diffusion, Portland, OR, 29 Sep. - 2 Oct. 1992
(Contract DE-FG02-92ER-61361)
(DE93-002164; CONF-9209158-7) Avail: CASI HC A01/MF A01

Boundary-layer cumulus clouds play an important role in surface energy budget via the interaction between clouds and radiation. In turn, the formation and evolution of these clouds are dependent upon the boundary layer turbulence structure. In this study, HAPEX aircraft sounding and near-surface horizontal flight-leg data are used to calculate the distributions of the mixed-layer height, the lifting condensation level (LCL), the level of free convection, and the limit of convection level. The joint distributions of LCL and mixed-layer height, and LCL and near-surface virtual potential temperature are used to diagnose boundary-layer cumulus-cloud coverage, which then are compared with HAPEX airborne cloud observations. DOE

N93-22408# Maryland Univ., College Park. Dept. of Meteorology.
ICRCCM. PHASE 2: VERIFICATION AND CALIBRATION OF RADIATION CODES IN CLIMATE MODELS
R. G. Ellingson, W. J. Wiscombe, D. Murcray, W. Smith, and R. Strauch 1992 15 p
(Contract DE-FG05-90ER-60971)
(DE93-005114; DOE/ER-60971/3) Avail: CASI HC A03/MF A01

Following the finding by the InterComparison of Radiation Codes used in Climate Models (ICRCCM) of large differences among fluxes predicted by sophisticated radiation models that could not be sorted out because of

the lack of a set of accurate atmospheric spectral radiation data measured simultaneously with the important radiative properties of the atmosphere, our team of scientists proposed to remedy the situation by carrying out a comprehensive program of measurement and analysis called SPECTRE (Spectral Radiance Experiment). The data collected during SPECTRE form the test bed for the second phase of ICRCCM, namely verification and calibration of radiation codes used in climate models. This should lead to more accurate radiation models for use in parameterizing climate models, which in turn play a key role in the prediction of trace-gas greenhouse effects. This report summarizes the activities of our group during the project's Third year to meet our stated objectives. The report is divided into three sections entitled: SPECTRE Activities, ICRCCM Activities, and summary information. The section on SPECTRE activities summarizes the field portion of the project during 1991 and the data reduction/analysis performed by the various participants. The section on ICRCCM activities summarizes our initial attempts to select data for distribution to ICRCCM participants and at comparison of observations with calculations as will be done by the ICRCCM participants. The Summary Information section lists data concerning publications, presentations, graduate students supported, and post-doctoral appointments during the project. DOE

N93-22584# Stanford Univ., CA. Linear Accelerator Center.

AN EXPERIMENTAL SEARCH FOR GAMMA RADIATION ASSOCIATED WITH THUNDERSTORM ACTIVITY

D. Fryberger Nov. 1992 8 p Presented at the 3rd International Symposium on Ball Lightning, Pasadena, CA, 28-30 Jul. 1992

(Contract DE-AC03-76SF-00515)

(DE93-006939; SU-SLAC-PUB-5980; CONF-9207177-1) Avail: CASI HC A02/MF A01

This experiment is a repeat of an earlier experiment, but with more sensitive apparatus and in a location with a higher incidence of thunderstorm activity. The earlier experiment was undertaken by Ashby and Whitehead to investigate the theory that ball lightning might be associated with the annihilation of small amounts of antimatter, and it yielded some very interesting but inconclusive results. In the course of about 12 months of data taking, four high rate bursts of gamma radiation were detected. These events lasted a few seconds and had many thousands of counts (16500, 5000, 3700, and greater than 7700). Unfortunately, the association of these gamma ray bursts with thunderstorms or ball lightning was not clearly established, although one of the bursts did occur during a local thunderstorm in rough coincidence with a lightning bolt striking a flagpole about 100 yards from the gamma ray detection crystals. A pulse height spectrum taken for this burst (no spectrum was taken for the other three) exhibited a significant peak, well above background, the energy of which appeared to be compatible with the 511 keV positron annihilation line. While the peak could not be unambiguously attributed to positron annihilation, this certainly appeared to be the most likely source. DOE

N93-22595# Sandia National Labs., Albuquerque, NM.

LOCAL LIGHTNING EARLY WARNING SYSTEM (LLEWS), PHASE 1

R. J. Fisher Dec. 1992 49 p

(Contract DE-AC04-76DP-00789)

(DE93-006609; SAND-92-2446-Phase-1) Avail: CASI HC A03/MF A01

Results are presented of a detailed survey of the present state of scientific understanding of cloud electrification processes and lightning warning technology. A review is given of the principles of operation and demonstrated performance factors of lightning strike location technologies and associated commercial products. Emphasis is given to the local lightning warning problem, which is divided into two categories: detection and tracking of active storms that originate outside of and move into the declared safety zone, and early detection of cloud electrification that initiates within the zone. A prototype single-station warning system design is presented that is intended to accumulate data simultaneously from a complement of different types of sensors during intervals immediately preceding the onset of lightning conditions within the area of coverage. The resultant data base will be analyzed statistically to identify the most promising combinations of early warning indicators and to quantify their reliability as a function of the warning intervals they provide. DOE

N93-22653*# Wisconsin Univ., Madison. Cooperative Inst. for Meteorological Satellite Studies.

INVESTIGATION OF CLOUD/WATER VAPOR MOTION WINDS FROM GEOSTATIONARY SATELLITE Final Report

Mar. 1993 7 p

(Grant NAG8-892)

(NASA-CR-192274; NAS 1.26:192274) Avail: CASI HC A02/MF A01

This report summarizes the research work accomplished on the NASA grant contract NAG8-892 during 1992. Research goals of this contract are the following: to complete upgrades to the Cooperative Institute for Meteorological Satellite Studies (CIMSS) wind system procedures for assigning heights and incorporating first guess information; to evaluate these modifications using simulated tracer fields; to add an automated quality control system to minimize the need for manual editing, while maintaining product quality; and to benchmark the upgraded algorithm in tests with NMC and/or MSFC. Work progressed on all these tasks and is detailed. This work was done in collaboration with CIMSS NOAA/NESDIS scientists working on the operational winds software, so that NASA funded research can benefit NESDIS operational algorithms. Author

N93-22722# Wisconsin Univ., Madison. Dept. of Atmospheric and Oceanic Sciences.

A CONVECTIVE DRAG THEORY FOR SURFACE FLUXES

R. B. Stull 1992 4 p Presented at the 10th Symposium on Turbulence and Diffusion, Portland, OR, 29 Sep. - 2 Oct. 1992

(Contract DE-FG02-92ER-61361)

(DE93-004037; CONF-9209158-10) Avail: CASI HC A01/MF A01

Concluding remarks are as follows: (1) weather and climate forcast models that might not have fine enough grid spacing to resolve the survace layer can utilize mixed-layer quantities in the parameterization proposed here; and (2) remote sensors such as satellite-borne radiometers or ground-based high-spectral-resolution interferometer spectrometers (HIS) can use radiometric data to estimate fluxes. DOE

N93-22733# Science and Technology Corp., Hampton, VA.

REGIONAL-SCALE ANALYSIS AND FORECASTING Final Report, May 1991 - Sep. 1992

John Burgeson, Isidore Halberstam, Christopher Redder, and Ralph Shapiro Sep. 1992 182 p Prepared in cooperation with Hughes STX Corporation, Lexington, MA

(Contract F19628-89-C-0167)

(AD-A259894; STC-TR-2660; PL-TR-92-2227) Avail: CASI HC A09/MF A02

This final report completes the description, begun in the interim report, of the development of the regional-scale analysis and forecasting procedure (RAP). The RAP is based on multivariate optimum interpolation of observations selected rigorously by the forward stepwise regression procedure. The complete observation set undergoes a unique buddy check that carefully eliminates those observations that adversely affected the analysis. The scheme used regionally-developed univariate and bivariate forecast error correlations, which were a function of distance between observations. The models are stratified by region, season, standard atmospheric levels, and forecast lengths. The models are superior to the model described in the interim report, and the models are shown to be applicable to rawinsonde and satellite observations. Results of verification experiments with numerical analyses of real data showed that the RAP concept is viable. Observing system simulation experiments (OSSEs) further verified the quality of RAP and the validity of the developed correlation models. In addition, the OSSEs provided relative confidence estimates of the quality of RAP analyses. An interesting forecasting procedure was recommended that extended the RAP analyses into a short-range forecast. GRA

N93-22765# Mitre Corp., McLean, VA. Program Office.

CHAMMP

H. Abarbanel, R. Chervin, P. Colella, F. Dyson, and S. Flatte 17 Dec. 1992 61 p

(AD-A260190; JSR-91-310) Avail: CASI HC A04/MF A01

The DOE CHAMMP program's stated goal is to develop, verify, and apply a new generation of climate model within a coordinated framework. The JASON review of the CHAMMP program took place during early July

1991. The topics covered include the following: fluctuation-correlation relationship, EOS, MIMD, climate, and auto covariance. GRA

N93-22772# Los Alamos National Lab., NM.
PROGNOSTIC CLOUD WATER IN THE LOS ALAMOS GCM
J. E. Kristjansson and C. Y. J. Kao 1992 4 p Presented at the 4th AMS Symposium on Global Change Studies, Anaheim, CA, 14-19 Jan. 1993
(Contract W-7405-eng-36)
(DE93-000679; LA-UR-92-3029; CONF-930142-3) Avail: CASI HC A01/MF A01

In recent years the effect of clouds has emerged as the largest single source of uncertainty in predicting climate changes. Consequently, the treatment of clouds in general circulation models (GCM's) is receiving greater attention than before. The cloud treatment in most of today's GCM's is greatly simplified. An elaborate cloud treatment including prognostic cloud water is introduced in the Los Alamos GCM and the sensitivity of climate simulations investigated. DOE

N93-22964# California Univ., Berkeley. Lawrence Berkeley Lab.
METHOD OF MEASURING NIGHTTIME U-VALUES USING THE MOBILE WINDOW THERMAL TEST (MoWiTT) FACILITY
J. H. Klems Apr. 1992 18 p Presented at the 1992 American Society of Heating, Refrigerating, and Air-Conditioning Engineers Meeting, Baltimore, MD, 27 Jun. - 1 Jul. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004778; LBL-30032; CONF-9206112-4) Avail: CASI HC A03/MF A01

Although primarily designed for studying the dynamic net energy flows through fenestration systems over the full diurnal cycle, the Mobile Window Thermal Test (MoWiTT) Facility is also frequently used to measure nighttime U-values. These measurements have the advantage of incorporating the exterior film coefficient resulting from the true ambient conditions at a particular time and location, rather than relying on a laboratory simulation of some assumed average or extreme condition. On the other hand, the MoWiTT is a much more complicated facility than a laboratory hot box, and the number of potential error sources is correspondingly larger. The method of deriving the nighttime U-value from directly measured data and the effect of random and systematic errors are discussed. DOE

N93-23045# Federal Aviation Administration, Atlantic City, NJ.
PLAN FOR THE EVALUATION OF THE PROTOTYPE TERMINAL DOPPLER WEATHER RADAR (TDWR) SYSTEM
Baxter R. Stretcher Feb. 1993 22 p
(DOT/FAA/CT-TN92/44) Avail: CASI HC A03/MF A01

The purpose of this plan is to detail the procedural approach and methods to be employed in evaluating the air traffic control (ATC) interface of the prototype Terminal Doppler Weather Radar (TDWR) system. The plan describes the evaluation that will be performed at the Orlando International Airport (MCO) during the summer of 1992. The Federal Aviation Administration (FAA) Technical Center will be interested in the controller's and supervisor's evaluation of the Geographical Situation Display (GSD) and the Ribbon Display Terminal (RDT), installed at the ATC tower. The evaluation of these displays may determine the operational suitability of the TDWR in the National Airspace System (NAS). Author

N93-23064# Federal Aviation Administration, Atlantic City, NJ.
AIR TRAFFIC OPERATIONAL EVALUATION PLAN FOR THE PROTOTYPE AIRPORT SURVEILLANCE RADAR WIND SHEAR PROCESSOR (ASR-WSP) AT ORLANDO INTERNATIONAL AIRPORT
Radame Martinez Feb. 1993 17 p
(DOT/FAA/CT-TN92/45) Avail: CASI HC A03/MF A01

The Airport Surveillance Radar Wind Shear Processor (ASR-WSP) (also known as Airport Surveillance Radar-9 (ASR-9) modification for low altitude wind shear detection) is a production ASR-9 with an expanded weather channel for added processing capabilities. The primary mission of the ASR-WSP is to enhance the safety of air travel through the timely detection and reporting of hazardous wind shear in and near the terminal approach and departure zones of the airport. It will also improve the management of air traffic (AT) in the terminal area through the forecast of precipitation, and ultimately the detection of other hazardous weather phenomena. The ASW-WSP may be used as a stand-alone system at airports without a Terminal Doppler Weather Radar (TDWR) or Enhanced-Low Level Wind Shear Alert System (E-LLWAS), or in an integrated mode with either, or both, the TDWR and E-LLWAS. This plan outlines the Federal Aviation Administration's (FAA) operational evaluation of an ASR-WSP which will operate at Orlando International Airport (MCQ) during the summer of 1992. Data will be collected via questionnaires completed by air traffic controllers and supervisors. The results of the evaluation will be analyzed and any necessary changes will be made prior to full production. Author

N93-23090# National Weather Service, Fort Worth, TX. Southern Region.
NESTED GRID MODEL PERFORMANCE DURING COLD OFFSHORE AND WARM ONSHORE FLOW OVER THE GULF OF MEXICO
Paul R. Janish and Steven W. Lyons Oct. 1992 24 p
(PB93-108090; NOAA-TM-NWS-SR-144) Avail: CASI HC A03/MF A01

During the cool season, cold air outbreaks push into the southern United States, across the Gulf coast, and into the Gulf of Mexico. The cycle of cold air outbreak and return flow over the Gulf of Mexico has been defined by Crisp and Lewis (1992) as the return flow cycle. The cycle involves two distinct phases. The first phase of the cycle, known as the offshore flow phase, is defined as the movement of cold/dry air from the continent to the ocean. The second is defined as the movement of warmer/more moist air from the ocean to the continent and is called the onshore (or return) flow phase. The importance of the return flow cycle cannot be overemphasized. Forecasts of temperature, humidity, clouds, and precipitation along the Gulf Coast and farther north are directly dependent upon accurate predictions of air mass modification over the Gulf. Operational forecasters depend heavily on outputs from numerical weather prediction models in preparing their daily suite of products. Since correct simulations of the return flow cycle are critical, an evaluation of Nested Grid Model (NGM) performance was conducted during the cool season of 1988. Emphasis was placed on determining model strengths and weaknesses during the return flow cycle. Dissert. Abstr.

N93-23094# National Center for Atmospheric Research, Boulder, CO.
A STATISTICAL CHARACTERIZATION OF DENVER-AREA MICROBURSTS Final Report
Kimberly L. Elmore and John McCarthy Dec. 1992 56 p Sponsored in part by NCAR and NSF
(Contract DTFA01-82-Y-10513)
(DOT/FAA/NR-92/13) Avail: CASI HC A04/MF A01

This document describes statistical characteristics of microbursts that occurred in the Denver area during the summers of 1982 and 1984. The Joint Airport Weather Studies (JAWS) Project, conducted between 15 May and 13 August 1982, is the primary data source for this report, and radar data from the Classify, Locate and Avoid Wind Shear (CLAWS) Project are also included for microburst lines and low-reflectivity microbursts. All surface mesonet data come from the JAWS Project. This report describes the statistical characteristics of the JAWS and CLAWS data that have been analyzed to date and is intended to be used as a working document. It is primarily a compendium of several different sources brought together in a single document. Author

N93-23166 Virginia Univ., Charlottesville.
THE STRUCTURE AND ENERGETICS OF AMAZON SQUALL LINES Ph.D. Thesis
Harold Lloyd Massie, Jr. 1991 211 p
Avail: Univ. Microfilms Order No. DA9237649

The role of the Amazon Basin as a global center of action for deep convection is quantified in the context of the planet's heat balance. Mesoscale heat and moisture budgets are presented for three synoptic-scale coastal originating systems (COS) over the Amazon Basin during the 1987 wet season. The budgets are obtained from volumetric analyses of mesoscale rawinsonde data from the April-May 1987 Amazon Boundary Layer Experiment (ABLE-2B). Classification of cloud and rainfall components is based on data from Portable Automated Mesonet (PAM) towers, GOES images, and radar. Satellite measurements of the total active cloud area, coupled with the mesoscale budget calculations, are used to determine the system-wide vertical transport of heat as a function of the COS life cycle. Maximum heat transport occurs in the COS mature stage when the system has its maximum spatial extent. The instantaneous heat transport for the 300-100 mb layer in a mature COS equals nearly 20 percent of

the theoretical heat export requirement for the equatorial trough zone. A little more than half of the system-wide transport occurs in the dynamically active anvil cloud. Dissert. Abstr.

N93-23219 Florida State Univ., Tallahassee.
CLOUD INFLUENCE ON RADIATIVE COOLING OVER THE TIBETAN PLATEAU DURING THE SUMMER MONSOON PERIOD Ph.D. Thesis
Lei Shi 1992 172 p
Avail: Univ. Microfilms Order No. DA9233299

The spatial and temporal variations of tropospheric longwave cooling, shortwave heating and cloud effects on these processes over the Tibetan Plateau during the summer monsoon season of 1988 are studied using infrared and visible measurements from the Indian geosynchronous satellite (INSAT). Estimates of surface temperature, surface albedo, cloud amount, cloud height, cloud water content, and effective radius of cloud drops are incorporated in a 27-band infrared model and a 38-band solar model to calculate radiative divergence profiles. The effects of cloudiness are parameterized in terms of water/ice contents and effective radius. Cloud effective radius is obtained through an optimization scheme which minimizes the top-of-atmospheric shortwave flux differences between INSAT visible measurements and estimates from the solar model. A theoretically consistent parameterization scheme is developed for calculating the cloud asymmetry parameter as a continuous function of wavelength and effective radius. The mean radiative effect of cloudiness over the large-scale elevated plateau during the course of the summer monsoon is to cool the atmosphere. However, the cooling takes place by virtue of cloud-induced longwave cooling dominating cloud-induced shortwave heating. This is completely opposite of the conventional view in which cloud causes infrared warming and solar cooling. Vertically, cloud-induced radiative cooling is strongest in the middle troposphere with weaker cooling rates in the lower troposphere. Therefore, clouds contribute indirectly to an increase in atmospheric heating through reducing static stability and thus aid the release of latent heat by cloud systems. Plateau radiative cooling rates vary significantly through different monsoon phases, primarily due to variations in cloud forcing.
Dissert. Abstr.

N93-23232# National Center for Atmospheric Research, Boulder, CO. Research Aviation Facility.
THEORETICAL ERRORS ON AIRBORNE MEASUREMENTS OF: STATIC PRESSURE, IMPACT TEMPERATURE, AIR FLOW ANGLE, AIR FLOW SPEED
Philippe Nacass Nov. 1992 75 p Sponsored by National Science Foundation, Washington, DC
(PB93-136406; NCAR/TN-385+STR) Avail: CASI HC A04/MF A01

The measurement of the surface pressure distribution on the nose of an aircraft (Brown et al, 1983) from which the dynamic pressure and angles of attack and sideslip can be obtained, defines the velocity vector of the aircraft relative to the atmosphere. In this report, a complete theory development gives an exact calculation for all angles with irrotational flow around a sphere, the easiest shape for a nose radome. But when a hemisphere is fixed on a long cylindrical portion the calculations of overspeed and pressure coefficient of the whole sphere are only approximations. Thus, an error is made in the measurements of the surface pressure distribution on the aircraft radome and on the angles of attack and sideslip. Most authors consider that the pressure coefficient is equal to zero on inlet sensors. GRA

N93-23282# National Oceanographic Data Center, Washington, DC.
MARINERS WEATHER LOG, VOLUME 36, NUMBER 3, SUMMER 1992 Quarterly Report
Richard M. DeAngelis, ed. 1992 99 p
(PB93-132033) Avail: CASI HC A05/MF A02

Contents: The Observation -- The importance of ship observations to forecasters; Savers of Lives -- Gallant men who risked their lives to save mariners; USCGC Tamaroa -- Modern Day Lifesavers -- Coast Guard comes through in the Halloween Storm; and Western North Pacific Typhoons -- 1991 -- An above average year for Super Typhoons. GRA

N93-23283# National Oceanographic Data Center, Washington, DC.
MARINERS WEATHER LOG, VOLUME 36, NUMBER 4, FALL 1992 Quarterly Report
Richard M. DeAngelis 1992 95 p
(PB93-132041) Avail: CASI HC A05/MF A01

Contents: Derelict Ships -- Tales of terrifying wrecks, ghost ships, and things that go bump in the night; Overdue -- For over 60 years, the loss of the Kobenhavn has been a mystery of the sea; Hurricane Andrew -- A First Look -- A preliminary report on a devastating storm; Monitor National Marine Sanctuary -- The Civil War vessel that launched a national sanctuary movement. GRA

N93-23305# Los Alamos National Lab., NM.
APPLICATION OF SPATIALLY AVERAGING OPTICAL TECHNIQUES TO THE STUDY OF SHORT-TERM FLUX CHANGES ASSOCIATED WITH CLOUDS
W. Porch, F. Barnes, M. Buchwald, J. Stephens, J. A. Archuleta, and K. Kunkel (Illinois State Water Survey, Champaign.) 1992 7 p Presented at the 4th American Meteorological Society (AMS) Symposium on Global Change Studies, Anaheim, CA, 14-19 Jan. 1993
(Contract W-7405-eng-36)
(DE93-000690; LA-UR-92-2960; CONF-930142-2) Avail: CASI HC A02/MF A01

Cloud formation remains one of the largest uncertainties in Global Circulation Models (GCMs). Most GCM's predict fewer clouds and positive feedback under increased greenhouse gas conditions. However, cloud formation occurs on much smaller scales than GCMs can resolve and is intimately tied to small scale fluxes of heat, water vapor, and cloud condensation nuclei. It is critical to understand how values of these fluxes are distributed is space and time before reliable cloud parameterizations can be expected in GCMs. We describe in this volume an experiment designed to improve our understanding of how point measurements of heat, water vapor, and surrogate parameters scale to regional differences in land use (on the order of 10 to 20 km in irrigated agricultural and prairie grassland). Our role was to explore the use of optical techniques to provide spatially-averaged flux and wind convergence measurements and relate these to cloud variability. DOE

N93-23332# European Space Agency, Paris (France).
SHADOW TECHNIQUE FOR IMPROVED INVERSION OF LIDAR DATA TO CIRRUS AND CONTRAIL OPTICAL DEPTH
Gerhard H. Ruppersberg (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany.) and Wolfgang Renger (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany.) Aug. 1992 21 p Transl. into ENGLISH of Invertierung der Lidarsignale von Cirrus und Kondensstreifen unter Nutzung des Schattenwurfes Original language document was announced as N92-14571
(ESA-TT-1263; DLR-FB-91-07; ETN-93-93585) Avail: CASI HC A03/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany HC

A striking feature of lidar images of back scattered signals from a cirrus cloud, received using an airborne upwardly measuring lidar system during the International Cirrus Experiment of 1989, is the shadowing by an underlying contrail. The lidar system can be calibrated with the aid of this shadowing, so that the extinction coefficients in the contrail are yielded with an accuracy of +/- 20. A spatial variation in their sigma/beta value in the contrail can be localized accordingly and determined quantitatively. The extinction coefficients in the measurement region outside the shadowing layer is obtained after making an assumption concerning the sigma/beta values effective there in relation to a sigma/beta relationship on the shadowing layer. This 'shadow calibration' can provide effective support for the frequently used Klett technique. The calibration is also conceivable for a fixed, vertically sounding lidar system, and permits novel interpretations in the case of downwards lidar soundings of the atmosphere. ESA

N93-23333# National Center for Atmospheric Research, Boulder, CO. Mesoscale and Microscale Meteorology Div.
REAL-TIME FORCASTS FOR WISP-91 USING THE PENN STATE/NCAR MESOSCALE MODEL
Phillip L. Haagenson, David O. Gill, and Ying-Hwa Kuo Oct. 1992 53 p Sponsored by National Science Foundation, Washington, DC
(PB93-118586; NCAR/TN-380+STR) Avail: CASI HC A04/MF A01

During the period from 1 January through 3 April 1991, researchers in the Winter Icing and Storms Project (WISP-91) used the Penn State University/National Center for Atmospheric Research (PSU/NCAR)

mesoscale numerical model (MM4) to provide high-resolution forecasts of the airflow, liquid water, and precipitation fields in the Front Range area of Colorado. Twenty-five pairs of 36-h forecasts were generated, using two different analysis systems to isolate the impact of different initial conditions on the forecast product. One system (standard) employs a modified Cressman objective analysis. The other system, MAPS, is a 3-h intermittent data assimilation system consisting of synoptic and asynoptic-data ingest. A two-way interacting nested version of MM4 was employed, with a fine-grid interval of 30 km and a coarse-grid interval of 90 km. Each forecast required approximately 2.5 CPU hours on one processor of NCAR's Y-MP/864 supercomputer. The model output display included hourly convective and stable precipitation rates, and spatial distribution of q(sub c) and q(sub r). Author

N93-23350 Reading Univ. (England).
THE VERTICAL PROFILE OF REFLECTIVITY AND ERRORS IN RADAR ESTIMATES OF RAINFALL Ph.D. Thesis
Warren R. Gray 1991 216 p
Avail: Univ. Microfilms Order No. BRDX97551

From an investigation of the errors invcIved in the estimation of surface precipitation by radar it becomes apparent that the Vertical Profile of Reflectivity (VPR) is the prime source of uncertainty. This project considers how operational radar data from 4 elevation angles out to a range of 75 km, can be used to develop estimates of the VPR. VPR information from several ranges has been composited using an eigenvector analysis method. Eigenvectors were formed from the 4 beam data, the primary eigenvectors then combined to form an estimate of the average VPR. The structure and amplitude of the secondary eigenvectors were found to be related to the location of the Bright Band (BB) and its time variations. The time series of the amplitudes of the primary eigenvectors provides a poor estimate of surface rainfall. Taking into account the second eigenvector improves the rainfall estimation, suggesting that the variation of height of the BB is important when estimating surface rainfall. The observed VPR is modelled with simple structure functions consisting of a linear decrease in reflectivity with height superimposed on a BB. The complete profile is described as a function of just 4 physically significant variables. The lowest radar beam data is corrected using the parameterized storm average profile. Following correction the bias of the average raingauge/radar comparison is reduced by 17.6 percent and the spread is decreased by 37.5 percent. However, the same method is less successful when applied to data averaged over half-hour intervals. A simple cloud physics model was developed in order to investigate the effects of variations in rainrate and environmental conditions. The profile is shown to be strongly dependent on rainrate, especially when 'observed' by radar. It is concluded that the VPR corrections based only on radar data can provide useful improvements to the estimation of 'storm averaged' precipitation. Dissert. Abstr.

N93-23351 Miami Univ., Coral Gables, FL.
SURFACE RADAR STUDIES OF RAIN ESTIMATION IN CORRELATION WITH INFRARED AND VISIBLE TECHNIQUES OF INSAT AND GOES-E GEOSTATIONARY SATELLITES Ph.D. Thesis
Aziz ur-Rahman Malik 1992 227 p
Avail: Univ. Microfilms Order No. DA9239665

This study explores further the application of the radar reflectivity and the derivation of the empirical relationship linking the rainfall parameters to the radar observables reflectivity (Z), differential reflectivity (Z(sub DR)) and attenuation (K), using exponential raindrop size distribution (N(D). The IR data in the range of 10.5-12.5 microns from INSAT-1B and 10.5-12.6 microns from GOES-E geosynchronous satellites have been used to estimate the rainfall rate using the technique by Stout, Martin and Sikdar (1979) in enhanced IR images. In case of INSAT, four months were processed to show the different variations in rainfall. The months chosen were July 85, October 85, January 86 and April 86. The rainfall estimations from GOES-E over the Florida peninsula were compared with raingage measurements and the accuracy of the rain estimations were discussed. We have observed that in general the satellite estimates are suggesting volumetric rainfall which is slightly less than that inferred from ground truth by actual rainfall observations as determined from raingages. A possible explanation is that the convective cycle for clouds over tropical lands may not be thoroughly inferred from satellite images due to 30-minutes interval between two images and because of the diurnal heating which tends to produce quite explosive convective development. The results suggested that the satellite convective daily rainfall estimation technique by Stout and Martin can provide rain estimates of considerably high utility on the convective scale when combined with the Scofield/Oliver (1977, 1978, and 1980) technique, especially for large and deep convective systems over tropical oceans as well as lands. Dissert. Abstr.

N93-23384 Kansas Univ., Lawrence.
A SATELLITE-BASED RADAR WIND SOUNDER (RAWS) Ph.D. Thesis
Weizhuang Xin 1991 184 p
Avail: Univ. Microfilms Order No. DA9238732

The objective of this study is to investigate the application of Doppler radar systems for global wind measurement. A model of the satellite based radar wind sounder (RAWS) is discussed, and many critical problems in the designing, such as the antenna scan pattern, tracking the Doppler shift caused by satellite motion, and backscattering of radar signals from different types of clouds, are discussed along with their computer simulations. In addition, algorithms for measuring mean frequency of radar echoes, such as the FFT estimator, the covariance estimator, and the estimators based on autoregressive models, are discussed. Monte Carlo computer simulations were used to compare the performance of these algorithms. Anti-alias methods are discussed for the FFT and the autoregressive methods. Several algorithms for reducing radar ambiguity were studied, such as random phase coding methods and staggered PRF methods. Computer simulations showed that these methods are not applicable to the RAWS because of the broad spectral widths of the radar echoes from clouds. A waveform modulation method using the concept of spread spectrum and correlation detection was developed to solve the radar ambiguity. Radar ambiguity functions were used to analyze the effective signal-to-noise ratios for the waveform modulation method. The result showed that, with suitable bandwidth product and modulation of the waveform, this method can achieve the desired maximum range and maximum frequency of the radar system. Dissert. Abstr.

N93-23494 Pennsylvania State Univ., University Park.
SOUTHWARD BURST MESOSCALE CONVECTIVE SYSTEMS: AN OBSERVATIONAL AND MODELING STUDY Ph.D. Thesis
David Jonathan Stensrud 1992 202 p
Avail: Univ. Microfilms Order No. DA9236905

Southward burst mesocale convective systems (MCSs) observed to have a component of motion in the upstream direction occurred over the southern Plains states of 11 and 12 May 1982. The MSCs are studied using observations and numerical simulations from the Penn State/National Center for Atmospheric Research mesoscale model. The large-scale flow creates a broad region of potential buoyant energy but owing to weak large-scale forcing for upward motion and a restraining inversion, convection only is initiated where lifting associates with mesoscale features is able to eliminate the inversion. A series of eastward moving MCSs develop sequentially and propagate across the moist tongue. Each system produces an outflow of cold downdraft air that spreads progressively farther south than that from the preceding system. This conceptual model of the development and evolution of convection is very different from traditional models where convection develops and propagates more or less in phase with traveling upperlevel disturbances. Two 12-h simulations are conducted, beginning at 1200 UTC 11 May and 0000 UTC 12 May, respectively, to evaluate the ability of the mesoscale model to reproduce this complex evolution of events. The model reproduces the timing of initial convective development very well, while it errs in regard to propagation rates and amount of convection. This is attributed to the model parameterization schemes having a greater influence on the evolution of convection when the large-scale forcing is weak. Thus, any inaccuracies in these schemes can easily lead to divergences of the simulation from the observations. The simulations also show that initial conditions created using only the large-scale observations are not sufficient to reproduce the events accurately. These initial conditions are modified to include mesoscale features, such as convective outflows, indicated in the surface and satellite data, but not well sampled by the upper-air observations. The improved initial conditions produce a much more reasonable simulation of the events, illustrating the importance of incorporating mesoscale features in model initial conditions when the large-scale forcing is weak. Including mesoscale features in model initial conditions is an unexplored aspect of present initialization schemes. Dissert. Abstr.

N93-23495 Maryland Univ., College Park.
THE INFLUENCE OF VARIATIONS OF VEGETATION AND SOIL MOISTURE ON SURFACE WEATHER AND ATMOSPHERIC CIRCULATION Ph.D. Thesis
Runhua Yang 1992 231 p
Avail: Univ. Microfilms Order No. DA9234693

The influence of variations of vegetation and soil moisture on surface weather and atmospheric circulation is studied through the use of the Simple Biosphere Model (SiB) and the Center for Ocean-Land-Atmosphere interactions (COLA) GCM. Tests for the SiB sensitivity to the conversion of the forest to other short vegetation or bare soil were performed at Amazonian and Great Plains sites, and a North Wales spruce forest site respectively. The results show that deforestation has a significant influence on the local surface energy budget and surface weather. The influence is especially prominent at the Amazon and Great Plains sites, and larger in summer than in other seasons. The influence on the partitioning of surface incoming radiative energy is generally constrained by the local atmospheric boundary condition. The sensitivity of the COLA GCM to changes in initial soil wetness (ISW) is determined by repeating three 10-day model integrations with the same initial and boundary conditions as the control runs except the values of ISW, which are revised at 69 model grid points covering much of the continental U.S. It is found that the relations between the changes in the 5-day mean forecast surface air temperature/surface specific humidity and the changes in ISW depend upon vegetation type and the values of ISW, and can be approximated by regression equations. These relations are also confirmed with independent data. With the ISW revised based on these regression equations the surface forecasts of the revised runs are consistently improved. The spatial scale of the ISW anomaly determines the degree and range of the influence. The influence of a small regional ISW change is mainly confined to the local region and to low atmospheric levels. The influence on surface fluxes is strong and persists for more than one month, but the effects on precipitation are relatively weak, changeable, and complex, particularly when an interactive cloud scheme is used. It is found that the moisture flux from the Gulf of Mexico can ameliorate drought conditions in the Great Plains in agreement with previously published results. Dissert. Abstr.

N93-23633# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
CLIMATE VARIABILITY IN A COUPLED GCM. PART 1: THE TROPICAL PACIFIC
Mojib Latif, Andreas Sterl, Ernst Maier-Reimer, and Martina M. Junge Sep. 1991 58 p
(Grant EV4C-0035-D(B))
(MPIM-73; ETN-93-93668) Avail: CASI HC A04/MF A01

A 26 year integration was performed with a Coupled ocean-atmosphere General Circulation Model (CGCM). The oceanic part resolves all three oceans in the latitude band 70 deg north to 70 deg south, but is dynamically active only between 30 deg north and 30 deg south. The atmosphere is represented by a global low order spectral model. The coupled model was forced by seasonally varying insolation. Although the simulated time averaged mean conditions in both atmosphere and ocean show significant deviations from the observed climatology, the CGCM realistically simulated the interannual variability in the tropical Pacific. In particular, the CGCM simulates an irregular ENSO (El Nino/Southern Oscillation) with a preferred time scale of about 3 years. The mechanism for the simulated interannual variability in the tropical pacific is related to both the 'delayed action oscillator' and the 'slow SST (Sea Surface Temperature) mode'. It therefore appears likely that, either the modes can coexist or they degenerate to one mode within certain locations of the parameter space. Experiments with a coupled model were conducted to study the sensitivity of coupled systems to varying mean oceanic background conditions. It is shown that even modest changes in the background conditions can push the coupled system from one flow regime into another. ESA

N93-23634# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
ON THE SPACE-TIME STRUCTURE OF ENSO
Mojib Latif, Andreas Sterl, and Ernst Maier-Reimer Oct. 1991 28 p
(Grant EV4C-0035-D(B))
(MPIM-74; ETN-93-93669) Avail: CASI HC A03/MF A01

The space-time characteristics of the El Nino/Southern Oscillation (ENSO) phenomenon were investigated by analyzing observational data and data derived from an extended range integration performed with a coupled ocean-atmosphere general circulation model. A considerable portion of the ENSO related low frequency variability in both data sets is shown to be associated with a cycle that involves slow propagation in the equatorial heat content and the surface wind field. In contrast, sea surface temperature is dominated by a standing component. The existence of this cycle implies the possibility of ENSO predictions up to lead times of about one year. This is shown by conducting a large ensemble of predictions with a simple statistical prediction scheme. ESA

N93-23649# National Weather Service, Fort Worth, TX. Scientific Services Div.
A COMPREHENSIVE GLOSSARY OF WEATHER TERMS FOR STORM SPOTTERS
Michael L. Branick (National Weather Service, Norman, OK.) Jan. 1993 30 p
(PB93-128940; NOAA-TM-NWS-SR-145) Avail: CASI HC A03/MF A01

The glossary contains weather-related terms that may be either heard or used by severe local storm spotters or spotter groups. Its purposes are (1) to achieve some level of standardization in the definitions of the terms that are used, and (2) provide a reference from which the meanings of any terms, especially the lesser-used ones, can be found. The idea is to allow smooth and effective communication between storm spotters and forecasters, and vice versa. A complete list of terms probably is impossible to arrive at, but this list is as comprehensive as possible. The definitions are written in what hopefully passes as 'layman's terms'. They are written to be easily understood by the storm spotter, regardless of his or her meteorological background. GRA

N93-23706# Air Force Environmental Technical Applications Center, Scott AFB, IL.
CLIMATOLOGICAL PROBABILITY OF CLOUD-FREE LINE-OF-SIGHT
Anthony J. Warren Dec. 1992 30 p
(AD-A260139; USAFETAC/TN-92-005) Avail: CASI HC A03/MF A01

This report describes how the climatological frequency distribution of cloud-cover is obtained and used to compute the climatological probability of cloud-free line-of-sight, or CFLOS. The probabilities can be estimated for an instantaneous point in time or for a specified time window (i.e., the probability of a continuous CFLOS for a time period of t minutes). The procedures outlined in the report are used by the USAF Environmental Technical Applications Center (USAFETAC) CPCFLOS computer program. An appendix describes the Burger Aerial Algorithm. GRA

N93-23710# Naval Oceanographic and Atmospheric Research Lab., Monterey, CA.
TROPICAL CYCLONE FORECASTERS REFERENCE GUIDE 2: TROPICAL CLIMATOLOGY Final Report
R. A. Jeffries, J. H. Chu, R. J. Miller, and C. R. Sampson Apr. 1992 75 p
(AD-A259922; NOARL-236) Avail: CASI HC A04/MF A01

One of the keys to safe and successful naval operations in the tropics is a thorough understanding of tropical meteorology. The Tropical Cyclone Forecasters Reference Guide is designed primarily as a ready reference for mid-latitude forecasters required to provide tropical meteorology support to staff commanders. This technical note provides a comprehensive overview of tropical climatology and is chapter 2 of the reference guide. Subjects discussed include major factors which affect the tropical climate, tropical synoptic models, wave disturbances, tropical vortices, and tropical cyclones. GRA

N93-23721 Texas A&M Univ., College Station.
USE OF SPECIAL SENSOR MICROWAVE/IMAGER (SSM/I) FOR ESTIMATION OF PRECIPITATION FEATURES IN A SEMI-ARID, MOUNTAIN REGION: A CASE STUDY OF SOUTHWEST SAUDI ARABIA Ph.D. Thesis
Abdul-Wahab Suliman Mashat 1992 129 p
Avail: Univ. Microfilms Order No. DA9300476

The linear regression method was used to determine the degree of correlation between soil caused by rainfall and Special Sensor Microwave/Imager (SSM/I) brightness temperatures or combinations of two brightness temperatures. This study is concerned with the application of passive microwaves to soil moisture classifications in a semi-arid, mountain region. The southwest region of Saudi Arabia was chosen for this study.

Two case studies were performed to investigate the response of SSM/I brightness temperatures to soil moisture. The first case study is at satellite ascending overpass time (about 6:00 a.m. local solar time), and the second case study is at satellite descending overpass time (about 6:00 p.m. local solar time). It is shown that brightness temperatures normalized with respect to ground temperature may be interpreted in terms of the soil moisture in the surface layer of the soil. Normalized brightness temperatures are not sensitive to soil moisture when precipitating clouds are present. The existence of precipitating clouds over the study area was determined through an examination of brightness temperatures at 8.5. GHz. It was found that the normalized brightness temperatures with respect to ground temperature responded to the change of the soil moisture caused by rainfall. The normalized brightness temperature in channel H19 with respect to ground temperature (H19/T) was the best single SSM/I channel to use for a surface soil moisture investigation at satellite descending overpass time, and the normalized brightness temperature in channel H37 with respect to ground temperature (H37/T) was the best single SSM/I channel to use for a surface soil moisture investigation at satellite ascending overpass time.
Dissert. Abstr.

N93-23968 North Carolina Univ., Chapel Hill.
SCENARIO DEVELOPMENT FOR THE NORTHEAST UNITED STATES 500 MILLIBAR HEIGHT FIELD Ph.D. Thesis
Arthur Neil Samel 1992 160 p
Avail: Univ. Microfilms Order No. DA9235017

The spatial distribution of the 500 mb height fields associated with the occurrence of surface sulfur dioxide and ozone pollution episodes over the Northeast United States was identified. Several characteristic patterns were found. A modified Kirchhofer analysis was used to develop climatologies of the frequency of days having each of these characteristic patterns. The first climatology was developed for observational data. Similar climatologies were then developed for general circulation model atmospheres with carbon dioxide concentrations near the current value and after an effective doubling to produce a scenario of the future percentage of days similar to the characteristic patterns. A comparison between climatologies generated with observed data and model output from the atmosphere with current carbon dioxide levels revealed that the model produced a small percentage of days characterizing ozone episodes. This resulted from lower heights, caused by unrealistically low greenhouse gas concentrations in the model atmosphere. The model atmosphere reproduced the observed seasonality of days classified with the characteristic patterns. However, the disparity between climatologies generated with observed and model data precluded use of the observational information in an estimation of future conditions. Rather, the development of a scenario of future height fields had to be based on a comparison between the two model climatologies. This scenario indicates that neither the percentage of days similar to the sulfur dioxide characteristic patterns nor the seasonality of these days will change. The percentage of days similar to the ozone characteristic patterns will more than double, giving both more days during the summer, and an expansion of the period of occurrence into spring and autumn. While these results suggest little change in the number of sulfur dioxide pollution episodes and a large increase in the number of ozone event days, little confidence should be placed in them until model atmospheres using current carbon dioxide concentrations are able to reproduce the observed climatology of the characteristic patterns.
Dissert. Abstr.

N93-23990# Oak Ridge National Lab., TN.
DEVELOPMENT AND APPLICATION OF PROCEDURES TO EVALUATE AIR QUALITY AND VISIBILITY IMPACTS OF LOW-ALTITUDE FLYING OPERATIONS Final Report, 1 Jul. 1988 - 15 Feb. 1990
E. J. Liebsch Jun. 1992 69 p
(AF Proj. 1900)
(AD-A259903; AFESC/ESL-TR-90-02) Avail: CASI HC A04/MF A01

The development and application of procedures to evaluate the potential air quality and visibility impacts of low-altitude aircraft flights are described. The impacts of pollutant emissions from aircraft engines were found to be potentially significant only with respect to PSD Class 1 air quality increments, which are applicable over certain national parks and wilderness areas.
GRA

N93-24004# Naval Postgraduate School, Monterey, CA.
INTRASEASONAL RELATIONSHIPS BETWEEN TROPICAL HEATING AND EXTRATROPICAL JETS M.S. Thesis
Michael T. Neith 14 Dec. 1992 108 p
(AD-A260212) Avail: CASI HC A06/MF A02

Intraseasonal variations of the northern midlatitude circulation and their relationships with the global tropical heating field are investigated using climate model fields. The greatest intraseasonal variance in the midlatitude flow is found in the vicinity of the time mean jets, and in the areas immediately downstream of these jet exits. The model kinetic energy field associated with these jets shows a clear 30-60 day variation and eastward propagation within and between the different jet regions. This intraseasonal behavior is found to be well correlated with heating anomalies in specific parts of the global tropics. For each of the jet regions, a simple composite analysis is used to identify the global heating patterns associated with periods of strong and weak flow. For the North Pacific jet, strong flow occurs during and after periods of positive heating anomalies in the tropical western and central Pacific, and negative heating anomalies in the Indian Ocean. Conversely, the North Pacific flow is weak when these heating anomalies are reversed. The North Atlantic jet shows comparable relationships, with positive heating anomalies in the tropical western and eastern Pacific, and negative heating anomalies in the tropical Indian and Atlantic Oceans, before and during periods of strong flow. These intraseasonal teleconnections between individual jets and the global tropical heating field are especially clear for the North Pacific and North Atlantic jets. In addition to relatively direct forcing from nearby tropical heat sources, the jets may be influenced by relatively remote tropical heat sources, whose signals propagate through upstream jets.
GRA

N93-24022# Naval Postgraduate School, Monterey, CA. Dept. of Operations Research.
PRELIMINARY RESULTS FROM THE ANALYSIS OF WIND COMPONENT ERROR, JULY DATA
Donald P. Gaver and Patricia A. Jacobs Nov. 1992 107 p
(AD-A259654; NPSOR-93-003) Avail: CASI HC A06/MF A02

Estimation of mean square prediction error of wind components is required in the optimal interpolation (OI) process in numerical prediction of atmospheric variables. Statistical models with log-linear scale parameters which include covariates are described for the prediction error. Data from February, April, and July of 1991 are used to fit the model parameters and to study the predictive ability of the models. This preliminary investigation indicates that observational and first guess wind components can be helpful in predicting mean square prediction error for wind components. The predictions using observational winds appear to be better at the 850 mb level. The predictions using first guess winds appear to be better at the 250 mb level.
GRA

N93-24061# World Meteorological Organization, Geneva (Switzerland).
WORLD METEOROLOGICAL ORGANIZATION Annual Report, 1991
1992 73 p
(WMO-774; ISBN-92-63-10774-2; ETN-93-93683) Copyright Avail: CASI HC A04/MF A01; World Meteorological Organization, Case Postulate no. 5, CH-1211 Geneva 20, Switzerland HC

An overview of the 11th World Meteorological Congress, which adopted the 3rd World Meteorological Organization (WMO) long term plan, reflecting the importance of major issues relating to environmental problems and sustainable development, is given. WMO activities relating to climate change and environmental issues, the global climate system in 1991, and the Kuwait oil fires, are described. Reports on the following programs are presented: World Weather Watch, World Climate, Atmospheric Research and Environment, Applications of Meteorology, Hydrology and Water Resources, Education and Training, Technical Cooperation, and Regional. Finance and personnel are outlined.
ESA

N93-24097# Naval Postgraduate School, Monterey, CA.
AN INVESTIGATION OF THE ERICA IOP-5A CYCLONE M.S. Thesis
Julia M. Spinelli Dec. 1992 114 p
(AD-A260214) Avail: CASI HC A06/MF A02

A synoptic investigation was conducted of the rapid coastal cyclogenesis event that occurred during Intensive Observation Period (IOP) 5A of the Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA). Navy Operational Regional Analysis and Prediction System (NORAPS)

objective analyses, utilizing operationally available and some special ERICA data, were examined in order to study the environment in which rapid development took place and to determine key synoptic and subsynoptic features important in the evolution of this storm. Additionally, the ability of NORAPS to accurately simulate the rapid cyclogenesis was investigated. Several processes contributed to the storm's intense development including strong low tropospheric temperature advection and upper-level cyclonic vorticity advection and divergence associated with a mobile trough and jet streak. NORAPS forecasts initialized 12 h prior to the explosive deepening phase of the IOP-5A cyclone provided a reasonably accurate simulation of the event. However, subjective hand analyses of hourly data for the period surrounding the onset of rapid deepening revealed the presence of a mesoscale coastal cyclone, which influenced the development of the storm. The development of this separate cyclone was not resolved by the model, resulting in a forecast track north of the actual storm's path. GRA

N93-24162 Saint Louis Univ., MO.
DYNAMIC AND THERMODYNAMIC CHARACTERISTICS OF A PRE-FRONTAL CONVECTIVE RAINBAND IN NORTHERN TAIWAN DETERMINED FORM TAMEX DATA Ph.D. Thesis
Hsiu-Wu Chang 1992 169 p
Avail: Univ. Microfilms Order No. DA9233787

In this study, structural features of a convective rainband associated with the Mei-Yu front on 25 June 1987 over northwestern Taiwan are investigated. dual-Doppler data were collected from the CP-4 and TOGA Doppler radars positioned along the northwest coast of Taiwan during the Taiwan Area Mesoscale Experiment (TAMEX). Fields of the system-relative wind and reflectivity were derived in a horizontal domain of 40 km by 36 km using an objective analysis scheme with 1 km grid spacing. Vertical velocities were computed from the anelastic continuity equation by integrating downward with variational adjustment. Results show that the low-level jet (LLJ) in the boundary layer provides large vertical shear ahead of the cold front. The depth of the cold air associated with the Mei-Yu front is rather shallow (1-2 km). To the south of the front, winds are from the southwest in the lower troposphere and veer with height in the middle and upper troposphere. The low-level convergence enhances lifting, resulting in a narrow band of convection on the warm side of the front. The rainband is composed of many cells which are accompanied by moderate convective updrafts (6-8 m s(exp -1) and weak downdrafts (2-4 m s(exp -1). Because the system traveled very slowly within the domain of interest, up to 200 mm of rainfall in 24 hours occurred on the west coast of Taiwan. The retrieved pressure and temperature fields are closely related to each other and are nearly in hydrostatic balance at most levels. The vertical component of horizontal momentum flux in a direction normal to the rainband is broadly countergradient, while the vertical momentum flux for the component parallel to the band is downgradient. The vertical transport of horizontal momentum during convection are largely responsible for the weakening of a LLJ and the growth of a MLJ as revealed by rawinsonde observations. Dissert. Abstr.

N93-24171# State Univ. of New York, Albany. Atmospheric Sciences Research Center.
THE USE OF THE AIR FORCE CLOUD COVER DATA TO EVALUATE AND IMPROVE CLOUD FORECAST AND PARAMETERIZATION IN MESOSCALE METEOROLOGY MODELS Annual Report, 1 Oct. 1991 - 30 Sep. 1992
Chris J. Walcek 25 Nov. 1992 28 p
(Contract F49621-92-J-0018)
(AD-A260357; AFOSR-92-1006TR) Avail: CASI HC A03/MF A01

This research program utilizes satellite and surface-derived cloud observations together with standard meteorological measurements to evaluate and improve our ability to accurately diagnose cloud coverage. Results of the research will be used to complement existing or future parameterizations of cloud effects in global and regional-scale meteorology forecast models, since nearly all cloud parameterizations must specify a fractional area of cloud coverage when calculating radiative or dynamic cloud effects, and current parameterizations rely on rather crude cloud cover estimates. GRA

N93-24239# National Climatic Data Center, Asheville, NC. Global Analysis Branch.
US NAVY REGIONAL CLIMATIC STUDY OF THE PERSIAN GULF AND THE NORTHERN ARABIAN SEA Final Report
William A. Brower, Jr., Ronald G. Baldwin, and Phala L. Franks Jul. 1992 272 p Sponsored by Naval Oceanographic Office
(AD-A260363; E/CC22; NAVAIR-50-1C-561) Avail: CASI HC A12/MF A03

This climatic study of The Persian Gulf and The Northern Arabian Sea consists of monthly isopleth charts and/or tables of the following: (1) clouds, (2) precipitation, (3) visibility, (4) mid and low range ceiling and visibilities, (5) wind- visibility-cloudiness, (6) mean scalar wind speed, (7) wind speed less than 11 knots and greater or equal to 34 knots, (8) wind speed 11-21 knots and 22-33 knots, (9) surface wind roses, (10) air and sea surface temperature, (11) wave height, (12) surface currents, and (13) station climate summaries. GRA

N93-24252# Computer Sciences Corp., Shrewsbury, NJ.
EFFECTS OF CLOUD COVER ON SATELLITE POSITIONING Scientific Report No. 3
Gary E. Gray, James H. Willand, and Albert R. Boehm 9 Nov. 1992 36 p
(Contract F19628-88-C-0089)
(AD-A260032; STX-SR-3; PL-TR-92-2289; AD-E201379) Avail: CASI HC A03/MF A01

The effect cloud cover would have on the Landsat-7 satellite at two different equatorial crossing times, 0945 or 1030 Mean Apparent Sun Time (MAST), is reported. Changes in the frequency of cloud cover observed in the two orbits are shown in maps and graphs. GRA

N93-24265# Oregon State Univ., Corvallis.
TURBULENT MICROFRONTS Final Report, 15 Jun. 1989 - 15 Oct. 1992
Larry Mahrt 5 Nov. 1992 9 p
(Contract DAAL03-89-K-0113)
(AD-A260300; ARO-26491.6-GS) Avail: CASI HC A02/MF A01

Turbulence structures in the atmospheric boundary layer were studied by focussing on microfronts. Microfronts are zones of sharp gradients which occur at the leading edge of wind gusts and upstream edges of thermals. Microfronts also result from convergence zones induced by horseshoe vortices and longitudinal roll vortices. The microfronts and their parent eddy structures account for the majority of the flux in the boundary layer, and in cases of strong winds, contribute to wind damage and structural fatique. However, existing methods, such as Fourier spectra, cannot be used to study microfronts which are local and aperiodic. In fact, microfronts and boundary layer eddies have been traditionally studied in terms of subjective conditional sampling. To avoid this subjectivity, objective techniques to study atmospheric turbulence from the microfront point of view were developed. These include new methods for computing spectra and filtering data. The techniques developed were then used to study coherent structures and their transport in the atmospheric boundary layer. GRA

N93-24272 Wisconsin Univ., Madison.
METEOROLOGICAL DATA ASSIMILATION BY ADAPTIVE BAYESIAN OPTIMIZATION Ph.D. Thesis
Robert James Purser 1992 167 p
Avail: Univ. Microfilms Order No. DA9223895

The principal aim of this research is the elucidation of the Bayesian statistical principles that underlie the theory of objective meteorological analysis. In particular, emphasis is given to aspects of data assimilation that can benefit from an iterative numerical strategy. Two such aspects that are given special consideration are statistical validation of the covariance profiles and nonlinear initialization. A new economic algorithm is presented, based on the imposition of a sparse matrix structure for all covariances and precisions held during the computations. It is shown that very large datasets may be accommodated using this structure and a good linear approximation to the analysis equations established without the need to unnaturally fragment the problem. Since the integrity of the system of analysis equations is preserved, it is a relatively straight-forward matter to extend the basic analysis algorithm to one that incorporates a check on the plausibility of the statistical model assumed for background errors-the so-called 'validation' problem. Two methods of validation are described

within the sparse matrix framework: the first is essentially a direct extension of the Bayesian principles to embrace, not only the regular analysis variables, but also the parameters that determine the precise form of the covariance functions; the second technique is the non-Bayesian method of generalized cross validation adapted for use within the sparse matrix framework. The later part of this study is concerned with the establishment of a consistent dynamical balance within a forecast model - the initialization problem. The formal principles of the modern theory of initialization are reviewed and a critical examination is made of the concept of the 'slow manifold'. It is demonstrated, in accordance with more complete nonlinear models, that even within a simple three-mode linearized system, the notion that a universal slow manifold exists is untenable. It is therefore argued that a consistent treatment of the initialization problem should strictly be guided by statistics as much as by dynamics; a new methodology to accomplish the unification of analysis and initialization within the Bayesian paradigm is proposed.
Dissert. Abstr.

N93-24286# Atmospheric and Environmental Research, Inc., Cambridge, MA. Hoffman,
ADVANCED RETRIEVAL AND ANALYSIS OF SATELLITE DATA FOR NUMERICAL WEATHER PREDICTION Final Report, 23 Feb. 1989 - 22 Aug. 1992
J. F. Louis, R. G. Isaacs, T. Nehrkorn, R. N. Hoffman, and C. Grassotti 10 Nov. 1992 80 p
(Contract F19628-89-C-0044)
(AD-A260036; AD-E201370; PL-TR-92-2229) Avail: CASI HC A05/MF A01

This report documents the development and testing of an advanced geophysical parameter retrieval, analysis and prediction system for global numerical weather prediction. the additions and improvements to the existing data assimilation system at the Phillips Laboratory are the following: a new surface pressure analysis, modifications for high resolution analysis, an optimal retrieval of SSM/T data based on Bayesian estimation, use of precipitation data to improve the moisture and divergence analysis and as input to a diabatic nonlinear normal mode initialization. The system uses a version of the advanced physics global spectral model of PL. The results of simulation tests show a significant improvement of the moisture analyses, especially in the tropics and Southern Hemisphere, and a smaller, but detectable improvement of the other variables, except in the stratosphere.
GRA

N93-24299# Texas Univ. at Dallas, Richardson. Center for Space Sciences.
DRIFT SCINTILLATION METER FOR THE DEFENSE METEOROLOGICAL SATELLITE PROGRAM Final Report, 12 Jan. 1988 - 30 Sep. 1992
B. J. Holt Oct. 1992 44 p
(Contract F19628-88-C-0046)
(AD-A259993; AD-E201301; UTD-FR-108-25011; PL-TR-92-2230) Avail: CASI HC A03/MF A01

This study describes the fifth instrument of the Drift Scintillation Meter (DSM2) which was built, tested, and delivered for flight on Air Force DMSP satellites. This report is divided into three sections. Section 1 contains the instrument description and theory of operation. Section 2 contains a description of spacecraft level instrument testing, stimulation requirements, and instrument handling and safety. Section 3 contains a list of the schematics, drawings, parts lists, and wiring lists that describes the as-built configuration of the instrument.
GRA

N93-24470# Utah Univ., Salt Lake City. Center for Atmospheric and Remote Sounding Studies.
MODELING OF CLOUD/RADIATION PROCESSES FOR TROPICAL ANVILS Annual Report, 1 Nov. 1991 - 31 Oct. 1992
Q. Fu, K. N. Liou, and S. K. Krueger 30 Nov. 1992 108 p
(Grant AF-AFOSR-0039-91)
(AD-A260203; AFOSR-93-0025TR) Avail: CASI HC A06/MF A02

Satellite imagery suggests that large portions of the tropics are covered by extensive cirrus cloud systems. Tropical cirrus clouds evolve during the life cycle of the mesoscale convective systems and are modulated by large-scale disturbances. Outflow cirrus clouds from tropical cumulonimbi appear to be maintained in a convectively active state by radiative flux gradients within the clouds, as suggested by Danielson (1982). Extensive anvils are likely to become radiatively distabilized by cooling at tops and warming at bases. This would drive convective fluxes which in turn would provide an upward flux of water vapor within the cloud. The additional moisture at cloud top levels would promote rapid ice crystal growth and fallout. Ackerman et al. (1988) have computed radiative heating rates in typical tropical anvils. The heating rate differences between the cloud bottom and top ranges from 30 to 200 K/day. Lilly (1988) has analyzed the dynamic mechanism of the formation of cirrus anvils using a mixed layer model, and has shown that destabilization of the layer could be produced by strong radiative heating gradients. The importance of radiative processes in the life cycle of tropical anvils and convective systems has also been illustrated by Chen and Cotton (1988) and Dudhia (1989). GRA

N93-24501# National Center for Atmospheric Research, Boulder, CO. Research Aviation Facility.
SIZE DEPENDENCE OF THE CHEMICAL PROPERTIES OF CLOUD DROPLETS: EXPLORATORY STUDIES BY AIRCRAFT Ph.D. Thesis
Cynthia H. Twohy 1992 250 p Sponsored by National Science Foundation, Washington, DC Prepared in cooperation with Washington Univ., Seattle
(Grant NSF ATM-88-13825)
(PB93-136117; NCAR/CT-137) Avail: CASI HC A11/MF A03

Clouds play an important role in the climate of the earth and in the transport and transformation of chemical species, but many questions about clouds remain unanswered. The chemical properties of droplets may vary with droplet size, with potentially important consequences. The counterflow virtual impactor (CVI) separates droplets from interstitial particles and gases in a cloud and also can collect droplets in discrete size ranges. As such, the CVI is a useful tool for investigating the chemical components present in droplets of different sizes and their potential interactions with cloud processes. Although the impaction characteristics of the CVI seem to be predictable by theory, the airborne instrument is subject to influences that may result in a reduced transmission efficiency for droplets, particularly if the inlet is not properly aligned. Ways to alleviate the problem are being investigated, but currently the imperfect sampling efficiency must be taken into account during data interpretation.
GRA

N93-24517# Atmospheric and Environmental Research, Inc., Cambridge, MA.
ASSESSMENT OF SPACEBORNE LIDAR FOR METEOROLOGICAL ANALYSES Final Report, 12 Jul. 1989 - 12 Jul. 1992
R. G. Isaacs, M. Mickelson, G. Molnar, C. Grassotti, and T. Nehrkorn 13 Jul. 1992 54 p
(Contract F19628-89-C-0137)
(AD-A260026; AD-E201377; PL-TR-92-2205) Avail: CASI HC A04/MF A01

This report summarizes results of a basic research program to investigate and develop advanced techniques for obtaining and applying meteorological parameters from spaceborne lidars. The focus of this program was to identify potentially inexpensive lidar sensor concepts which provide maximum paybacks in improvements to numerical weather prediction (NWP) model performance. As the result of a trade-off of potential lidar systems for measuring meteorological parameters such as temperature, moisture, and winds, it was determined that maximum payback for NWP could be achieved by improving the accuracy and coverage of wind observations. Since they will be available from a polar orbiter, coverage will be increased, especially for extratropical areas. The lidar will produce winds wherever there is a cloud and will likely provide boundary layer winds from maritime aerosol backscatter. The assessment of the impact of candidate satellite lidar observation concepts on numerical weather analysis and prediction models was performed through a series of observing system simulation experiments (OSSE's). In addition to NWP model impacts, the fusion of potential lidar sensor system data with that from the current Defense Meteorological Satellite Program (DMSP) suite of passive sensors was considered. Special emphasis was placed on investigating active/passive data fusion approaches for improving the retrieval of atmospheric temperature and moisture profiles and the analysis of clouds (i.e., nephanalysis) in support of tactical and strategic operations.
GRA

N93-24523*# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

CLIMATOLOGY OF STATION STORM RAINFALL IN THE CONTINENTAL UNITED STATES: PARAMETERS OF THE BARTLETT-LEWIS AND POISSON RECTANGULAR PULSES MODELS (Diskette Supplement)

Kelly Lynn Hawk and Peter S. Eagleson May 1992 331 p Diskette supplement: IBM compatible 5¼25-inch DSHD

(Contract NAS5-31721)

(NASA-CR-192968; NAS 1.26:192968; MIT-R92-19; MIT-336; NONP-Suppl-DK-93-159785) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A21

The parameters of two stochastic models of point rainfall, the Bartlett-Lewis model and the Poisson rectangular pulses model, are estimated for each month of the year from the historical records of hourly precipitation at more than seventy first-order stations in the continental United States. The parameters are presented both in tabular form and as isopleths on maps. The Poisson rectangular pulses parameters are useful in implementing models of the land surface water balance. The Bartlett-Lewis parameters are useful in disaggregating precipitation to a time period shorter than that of existing observations. Information is also included on a floppy disk. Author

N93-24568# Air Force Environmental Technical Applications Center, Scott AFB, IL.

ASPAM (ATMOSPHERIC SLANT PATH ANALYSIS MODEL) STATISTICAL PAIRED DIFFERENCES PILOT STUDY FOR SAMPLE SIZE DETERMINATION

Thomas H. Elio, Charles R. Coffin, and Lauraleen OConnor Nov. 1992 42 p

(AD-A260288; ATETAC-PR-92-005) Avail: CASI HC A03/MF A01

Methodology and results of a pilot study intended to determine the required PA sample size for a statistically significant seasonal study of the difference between ground truth (represented by upper-air soundings) and Atmospheric Slant Path Analysis Model (ASPAM) optimum interpolation vertical profiles (OIVP's) and alternate vertical profiles is described. This study builds on earlier studies, incorporating lessons learned and user feedback. It found that a sample size of 50 observations was enough to determine if the differences between ground truth (upper-air soundings) and ASPAM vertical profiles were significant at the customer's confidence level. Author (revised)

N93-24578 Rhode Island Univ., Kingston.

SENSITIVITY OF MODELED CRETACEOUS CLIMATE TO INSOLATION FORCING CREATED BY VARYING EARTH-SUN ORBITAL RELATIONSHIPS Ph.D. Thesis

Thomas J. Glancy, Jr. 1992 754 p

Avail: Univ. Microfilms Order No. DA9239558

Rhythmic sedimentation patterns observed within the Cretaceous Western Interior Seaway, such as those in the Bridge Creek Limestone Member of the Greenhorn Limestone Formation exposed near Pueblo, Colorado, appear to be a response to episodic climate change. These climatic variations could, in turn, be forced by the periodic insolation change over the North American continent created by Milankovitch-scale Earth-Sun orbital relationships - eccentricity (100 kiloyears), obliquity (41 kiloyears) and precession of the equinox (23 kiloyears). To test the sensitivity of Cretaceous climate to changes in Milankovitch-scale insolation forcing, a set of seasonal simulations using maximum difference insolation forcing conditions was conducted with the National Center for Atmospheric Research's Community Climate Model using 100 MA Cretaceous paleogeography and paleotopography. Analysis showed statistically significant differences in surface temperature, precipitation, surface wind, storm track location, and upwelling occurred over many regions of the Cretaceous Earth, particularly in the summer and winter monsoon system. During Northern Hemisphere winter, differences in the position of storm passage over Cretaceous western North America under maximum difference insolation forcing conditions varies the precipitation received over the southern Western Interior Seaway at the location where the Bridge Creek Limestone Member rhythmic sedimentation was produced. Northern Hemisphere winter simulations removing all sea ice from the model showed little difference in the climatic effects observed over southwestern North America from the case with sea ice present. Additional simulations varying only the obliquity within the model suggest that the observed Bridge Creek Limestone Member rhythmic sedimentation patterns are controlled by climatic change produced by cyclic variation in the precession of the equinox and eccentricity insolation forcing, rather than by periodic change in obliquity insolation forcing. Northern Hemisphere summer and winter global displays are provided for the numerical mean values of surface temperature, precipitation, zonal and meridional component wind and wind vector and storm track distribution produced by the various combinations of insolation forcing used in the computer simulations. Dissert. Abstr.

N93-24580 Virginia Univ., Charlottesville.

EQUATORIAL ATMOSPHERIC WEATHER REGIMES: THEIR STRUCTURE AND ROLE Ph.D. Thesis

Vickie Sue Connors 1991 171 p

Avail: Univ. Microfilms Order No. DA9237617

Infrared radiance measurements by the Geostationary Operational Environmental Satellite (GOES-6) from April 1986 through April 1987 are used to characterize and identify distinct regimes of persistent, large-scale cloudiness patterns over the Amazon Basin. These tropical weather regimes are responsible for the continental-scale atmospheric processes that transport air, trace gases, and heat from the Amazon Basin. The cloud patterns are represented by both scene-scale parameters, such as the cloud-free area and the value of the 'clear sky peak' in a histogram, and textural measures, such as contrast of cloudy area and homogeneity or cloudy area. Correlation analyses of the attribute arrays determined that only 9 of the original 15 cloud pattern descriptors are required for the cluster analyses. Seventy-six percent of the satellite images are classified into 1 of 14 weather regimes which persist for periods that range from 3 to 15 days each. The dominant weather regimes are described by the recurrence and duration of the events, by the rainfall produced and energy released to the tropical atmosphere, and by the composite kinematic and thermodynamic analyses. While the classification analyses identified a range of organized weather conditions in the Amazon Basin, two weather regimes, each occurring in separate seasons, dominate the year. The prominent dry season regime (A) occurs 11 times, persists for 25 percent of the year, produces 81 percent of the dry season rainfall, and 7 percent of the energy export necessary to balance the global heat budget. The prominent wet season regime (B) occurs 8 times, persists for 18 percent of the year, delivers about 30 percent of the wet season rainfall, and 16 percent of the energy export requirement. Because the dry season regime (A) draws nearly half of its water vapor supply from local sources, a vital link may exist between the rainforest ecosystem and the dry season rainfall. Dissert. Abstr.

N93-24588# National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.

OBSERVED ANNUAL AND INTERANNUAL VARIATIONS IN TROPOSPHERIC WATER Technical Memo

Dian J. Gaffen Nov. 1992 172 p

(PB93-123313; NOAA-TM-ERL-ARL-198) Avail: CASI HC A08/MF A02

Radiosonde observations from a global network of 56 stations for 1973-1990 were used to describe and quantify annual and interannual variations of tropospheric water vapor. After data inhomogeneities related to changes in instruments or observing practices were identified, monthly mean and anomaly datasets were constructed for dew point, specific humidity, relative humidity, temperature, and precipitable water from the surface to 500 mb. An empirical orthogonal function analysis of tropical specific humidity variations identified two important modes of variability. The first is a steplike increase in specific humidity that occurred in about 1976-1977, and the second is associated with the El Nino phenomenon. The increase is consistent with the results of an extensive trends analysis of the data, which showed evidence for increases in precipitable water at about half of the 39 stations studied, decreases at three, and no statistically significant trend at the others. Precipitable water trends were closely related to trends in dew point and specific humidity, as one would expect, but they were not always related to temperature trends. GRA

N93-22140# Japan Weather Association, Tokyo. Meteorological Information Center.

DATA SETS FOR WEATHER INFORMATION SERVICES

Sei-Ichi Saitou and Rikuyo Morimoto *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre

ISY International Symposium 31 Jan. 1992 p 267-276 (For primary document see N93-22119 08-43)
Avail: CASI HC A02/MF A03

N93-23835# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.
METEO DISC: SATELLITE CLOUD MOTION PRESENTATION BY INTERACTIVELY CONTROLLED VIDEO DISC FOR RESEARCH, TEACHING, AND TRAINING
Guenter Warnecke, Christian Zick, and Brian Toussaint *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1383-1385 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N93-22067# Marine Research Specialists, Ventura, CA.
PHYSICAL OCEANOGRAPHY OF THE US ATLANTIC AND EASTERN GULF OF MEXICO Final Report
John D. Milliman and Eiji Imamura Jun. 1992 519 p Sponsored by Minerals Managemment Service, Herndon, VA Prepared in cooperation with Woods Hole Oceanographic Inst., MA, and Marine Research Specialists, Ventura, CA
(Contract DI-14-12-0001-30350)
(PB93-123909; OCS/MMS-92/0003) Avail: CASI HC A22/MF A04

The report provides a summary of the physical oceanography of the U.S. Atlantic and Eastern Gulf of Mexico and its implication to offshore oil and gas exploration and development. Topics covered in the report include the following: meteorology and air-sea interactions, circulation on the continental shelf, continental slope and rise circulation, Gulf Stream, Loop Current, deep-western boundary current, surface gravity-wave climatology, offshore engineering implications, implications for resource commercialization, and numerical models of pollutant dispersion. GRA

N93-22225# Washington Univ., Seattle.
A GAS EXTRACTION SYSTEM FOR THE MEASUREMENT OF CARBON DIOXIDE AND CARBON ISOTOPES IN POLAR ICE CORES Ph.D. Thesis
E. Steig Jun. 1992 36 p
(Contract DE-AC05-76OR-00033)
(DE93-005289; DOE/OR-00033/T508) Avail: CASI HC A03/MF A01

Knowledge of the distribution of carbon 13 in the glacial ocean, atmosphere, and biosphere is important to understanding the causes of glacial/interglacial changes in atmospheric CO2 levels. Although deep-ocean carbon 13 values are well-constrained by ocean sediment studies, model-based estimates of changes in the carbon budget for the biosphere and atmosphere vary considerably. Measurement of atmospheric carbon 13 in CO2 in ice cores will provide additional constraints on this budget and will also improve estimates of changes in the ocean surface layer carbon 13. Direct measurement of ancient atmospheric carbon 13 can be accomplished through polar ice core studies. A gas-extraction line for ice cores was designed and constructed with particular attention to the specific difficulties of measuring carbon 13 in CO2. The ice is shaved, rather than crushed, to minimize fractionation effects resulting from gas travel through long air-paths in the ice. To minimize the risk of isotopic contamination and fractionation within the vacuum line, CO2 is separated immediately from the air; the CO2 concentration is then measured by a simple pressure/volume comparison rather than by gas chromatography or spectroscopy. Measurements from Greenland ice core samples give an average value of 280 plus or minus 2 ppm CO2 for preindustrial samples, demonstrating that the extraction system gives accurate, precise determinations of CO2 concentrations. Measurement of carbon 13 from polar ice samples was not achieved at this time. However, results on standard air samples demonstrate a precision for carbon 13 of less than 0.2 (per thousand) at the 95 percent confidence level. DOE

N93-22387*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ROWS WAVE SPECTRAL DATA COLLECTED IN SAXON-FPN, NOVEMBER 1990
F. Jackson, D. Vandemark, S. Bailey, C. Vaughn, D. Hines, J. Ward (Computer Sciences Corp., Wallops Island, VA.), K. Stewart (Computer Sciences Corp., Wallops Island, VA.), and B. Chapron (SM Systems and Research Corp., Landover, MD.) Washington Apr. 1993 64 p
(Contract N00173-80-WR-00281)
(NASA-TM-104582; NAS 1.15:104582; Rept-93B00064) Avail: CASI HC A04/MF A01

High-resolution directional wave spectra obtained with the NASA Ku-band radar ocean wave spectrometer (ROWS) on the Naval Research Laboratory P-3 aircraft during SAXON-FPN (SAR and X-Band Ocean Nonlinearities Experiment-Forschungsplattform Nordsee) experiments in the North Sea in November 1990 are presented. This experiment was the first in which the ROWS was operated with its new pc-based high-speed digital data acquisition system. Author

N93-22580# California Univ., San Diego, La Jolla.
MEASUREMENTS OF SURFACE OCEAN CARBON DIOXIDE PARTIAL PRESSURE DURING WOCE
1992 9 p
(Contract DE-FG03-90ER-60981)
(DE93-006890; DOE/ER-60981/T1) Avail: CASI HC A02/MF A01

This paper discusses the research progress of the second year of research under 'Measurement of Surface Ocean Carbon Dioxide Partial Pressure During WOCE' and proposes to continue measurements of underway pCO2. During most of the first year of this grant, our efforts to measure pCO2 on WOCE WHP legs were frustrated by ship problems. The R/V Knorr, which was originally scheduled to carry out the first work on WHP lines P19 and P16 in the southeastern Pacific during the 1990-91 austral summer, was delayed in the shipyard during her mid-life refit for more than a year. In the interim, the smaller R/V Thomas Washington, was pressed into service to carry out lower-latitude portions of WHP lines P16 and P17 during mid-1991 (TUNES Expedition). We installed and operated our underway chromatographic system on this expedition, even though space and manpower on this smaller vessel were limited and no one from our group would be aboard any of the 3 WHP expedition legs. The results for carbon dioxide and nitrous oxide are shown. A map of the cruise track is shown for each leg, marked with cumulative distance. Following each track is a figure showing the carbon dioxide and nitrous oxide results as a function of distance along this track. The results are plotted as dry-gas mole fractions (in ppm and ppb, respectively) in air and in gas equilibrated with surface seawater at a total pressure equal to the barometric pressure. The air data are plotted as a 10-point running mean, and appear as a roughly horizontal line. The seawater data are plotted as individual points, using a 5-point Gaussian smoother. Equal values of xCO2 in air and surface seawater indicate air-sea equilibrium. DOE

N93-22581# Scripps Institution of Oceanography, La Jolla, CA.
OCEANIC CO MEASUREMENTS FOR THE WOCE HYDROLOGICAL SURVEY IN THE PACIFIC OCEAN: SHIPBOARD ALKALINITY ANALYSES DURING 1991 AND 1992
C. D. Keeling 1992 3 p
(Contract DE-FG03-91ER-61116)
(DE93-006900; DOE/ER-61116/2) Avail: CASI HC A01/MF A01

Over a period of several years the DOE Carbon Dioxide Science Team is contributing measurements of the carbon cycle in sea water on transects of the WOCE Hydrological Survey sponsored by the United States. As noted in our report of 6 December, 1991, our laboratory is contributing measurements of titration alkalinity of sea water to this effort. This paper discusses technical progress made in 1992. DOE

N93-22668 State Univ. of New York, Binghamton.
THE INFLUENCE OF WIND-DRIVEN OCEAN CIRCULATION ON EARTH ROTATION Ph.D. Thesis
Daniel Jonathan Steinberg 1992 121 p
Avail: Univ. Microfilms Order No. DA9300995

We have studied the role of barotropic, wind driven ocean circulation in exciting polar motion and the length of day at weekly to seasonal frequencies. The rotation of the earth is variable in length of day and in position of the rotation pole. The sources of these variations are not fully known. We have used the Cox and Bryan (1984) general circulation ocean model driven by daily NMC global winds to compute first the ocean currents and sea level variations, and then the rotational excitation functions, between 1980 and 1986. We find that the wind driven ocean circulation can explain much of the residual power in the length of day which is not accounted for by atmospheric angular momentum. It also appears that there is significant power, as much as 50 percent of that needed, in polar motion excitation at the Chandler and seasonal frequencies. Dissert. Abstr.

N93-22700*# Alaska Univ., Fairbanks. Geophysical Inst.
THE INFLUENCE OF THE HYDROLOGIC CYCLE ON THE EXTENT OF SEA ICE WITH CLIMATIC IMPLICATIONS Final Report
Kenneson G. Dean, William J. Stringer, and Craig Searcy Mar. 1993 66 p Original contains color illustrations
(Grant NAGw-1835)
(NASA-CR-192772; NAS 1.26:192772) Avail: CASI HC A04/MF A01; 6 functional color pages

Multi-temporal satellite images, field observations, and field measurements were used to investigate the mechanisms by which sea ice melts offshore from the Mackenzie River delta. Advanced Very High Resolution Radiometer (AVHRR) satellite data recorded in 1986 were analyzed. The satellite data were geometrically corrected and radiometrically calibrated so that albedo and temperature values could be extracted. The investigation revealed that sea ice melted approximately 2 weeks earlier offshore from the Mackenzie River delta than along coasts where river discharge is minimal or non-existent. There is significant intra-delta variability in the timing and patterns of ice melt. An estimation of energy flux indicates that 30 percent more of the visible wavelength energy and 25 percent more of the near-infrared wavelength energy is absorbed by water offshore of the delta compared to coastal areas with minimal river discharge. The analysis also revealed that the removal of sea ice involves the following: over-ice-flooding along the coast offshore from river delta channels; under-ice flow of 'warm' river water; melting and calving of the fast ice; and, the formation of a bight in the pack ice edge. Two stages in the melting of sea ice were identified: (1) an early stage where heat is supplied to overflows largely by solar radiation, and (2) a later stage where heat is supplied by river discharge in addition to solar radiation. A simple thermodynamic model of the thaw process in the fast ice zone was developed and parameterized based on events recorded by the satellite images. The model treats river discharge as the source of sensible heat at the base of the ice cover. The results of a series of sensitivity tests to assess the influence of river discharge on the near shore ice are presented.
Author (revised)

N93-22804*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TOPEX/POSEIDON JOINT VERIFICATION PLAN
15 Jun. 1992 101 p
(Contract NAS7-918)
(NASA-CR-192792; NAS 1.26:192792; JPL-Publ-92-9) Avail: CASI HC A06/MF A02

TOPEX/POSEIDON is a satellite mission that will use altimetry to make precise measurements of sea level with the primary goal of studying global ocean circulation. The mission is jointly conducted by the United States' National Aeronautics and Space Administration (NASA) and the French space agency, Centre National d'Etudes Spatiales (CNES). The current plans call for a launch of the satellite in August 1992. The primary mission will last 3 years, and provisions were made to extend the mission for an additional 2 years. The mission was coordinated with a number of international oceanographic and meteorological programs, including the World Ocean Circulation Experiment and the Tropical Ocean and Global Atmosphere Program, both of which are sponsored by the World Climate Research Program. The observations of TOPEX/POSEIDON are timed to provide a global perspective for interpreting the in situ measurements collected by these programs and in turn will be combined with observations of other satellites to achieve a global, four-dimensional description of the circulation of the world's oceans. In the autumn of 1987, an international team of 38 Principal Investigators was selected to participate in the mission. These scientists have been working closely with the TOPEX/POSEIDON Project to refine the mission design and science plans. During the first 6 months after launch, a number of these investigators will join with the project to conduct a wide range of oceanographic and geophysical investigations using the TOPEX/POSEIDON data. The purpose of these investigations is to demonstrate the scientific utility of the mission to the international scientific community. Author (revised)

N93-22893# National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
TEMPORAL SAMPLING REQUIREMENTS FOR LOW FREQUENCY TEMPERATURE VARIABILITY IN THE EASTERN EQUATORIAL PACIFIC OCEAN
S. P. Hayes and M. J. McPhaden Nov. 1992 23 p
(PB93-136422; NOAA-TM-ERL-PMEL-96; CONTRIB-1404) Avail: CASI HC A03/MF A01

The effects of temporal subsampling of the near equatorial thermal field are examined using Monte-Carlo techniques. Approximately 3 years of continuous data from moored temperature sensors on the equator at 110 deg W and 140 deg W in the Pacific Ocean were randomly subsampled at frequencies of 1, 2, and 5 samples per month. Spectra of subsampled and original series demonstrate that the errors caused by subsampling are position, depth, and frequency dependent. In general, for a given number of samples errors are larger at the eastern location and in the thermocline. Adequate (spectral agreement to within a factor of two) resolution for periods longer than 3 months can be obtained at most depths with five samples per month. Fewer measurements are required near the surface.
GRA

N93-23010*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SeaWiFS TECHNICAL REPORT SERIES. VOLUME 8: PROCEEDINGS OF THE FIRST SeaWiFS SCIENCE TEAM MEETING
Stanford B. Hooker, ed., Wayne E. Esaias, Lisa A. Rexrode (General Sciences Corp., Laurel, MD.), and Elaine R. Firestone, ed. (General Sciences Corp., Laurel, MD.) Washington Mar. 1993 65 p Meeting held in Annapolis, MD, 19-22 Jan. 1993
(NASA-TM-104566; Rept-93B00061; NAS 1.15:104566) Avail: CASI HC A04/MF A01

The first meeting of the SeaWiFS Science Team was held in preparation for a launch of the SeaStar satellite carrying the SeaWiFS ocean color scanner in the October 1993 time frame. The primary goals of the meeting were: (1) to brief Science Team members, agency representatives, and international collaborators on the status of the mission by representatives from the SeaWiFS Project, the prime contractor Orbital Sciences Corporation (OSC), and the Goddard Distributed Active Archive Center (DAAC); (2) to provide for briefings on the science investigations undertaken by Science Team members and to solicit comments and recommendations from meeting attendees for improvements; and (3) to improve coordination of research and validation activities both inter- and intra-nationally with respect to collection, validation, and application of ocean color data from the SeaWiFS mission. Presentations and recommendations are summarized.
Author (revised)

N93-23130 Bristol Univ. (England).
THE ENVIRONMENTAL BIOGEOCHEMISTRY OF OPEN OCEAN AND PARTIALLY ENCLOSED MARINE SYSTEMS Ph.D. Thesis
Isabelle A. Dias 1990 244 p
Avail: Univ. Microfilms Order No. BRDX97368

The present study investigates the origin, distribution and fate of lipid biomarkers in the North Sea (particulates, sediments, zooplankton faecal pellets) and the Atlantic Ocean (surface water particulates), as representatives of partially enclosed and open marine systems. An extension and expansion (with the aid of GC and GC-MS) of the laboratory culture experiments performed by other workers was contemplated. A simultaneous study of chlorophyll and carotenoid pigments was executed in the Atlantic Ocean to determine (by HPLC) latitudinal variations in phytoplanktonic and detrital abundance, and the physiological status of the samples. Phytoplankton speciation and distribution was determined by microscopy at Plymouth Marine Laboratory, in an attempt to attribute biomarkers to putative marine sources. Potential correlations existing within the accumulated results were examined as a prelude to a more detailed inspection using a modified statistical software package (Principal Components Analysis - PCA) capable

of dealing with very large data sets with relative ease. Investigations of particulates (by microscopy) in the Atlantic Ocean, defined areas of high and low phytoplankton productivity along with associated zooplankton grazing activity. High productivity areas were dominated by diatoms, coccolithophores and dinoflagellates, whereas oligotrophic regions were populated mainly by cyanobacterial species. Applied PCA of the North Sea samples was useful for distinguishing individuals of varied origin into distinct groups on the basis of fatty acid and sterol content. Clusters emerged from amongst the different sample types, despite the range of species (particulates and zooplankton faecal pellets) and grain sizes (sediments) present. Similar treatment of the Atlantic pigment data enabled specific chlorophylls and carotenoids to be related to phytoplanktonic spatial abundances, and to productive oligotrophic regions. In addition, statistical analyses of the Atlantic sterol data differentiated high productivity, temperate waters containing diatoms, dinoflagellates and coccolithophores, from those of the oligotrophic South Atlantic, containing rod bacteria and cyanobacteria. Combined PCA of the entire fatty acid data set (94 samples and 73 acids) discriminated the open and enclosed marine systems. However, such examinations of the Atlantic FAME's data and the combined analysis of the complete sterol data (94 samples) were unsuccessful. This was due to the ubiquitous origins of the lipids under scrutiny. In conclusion, PCA was found to be an effective and efficient tool in the analyses of these data matrices. Author

N93-23138*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ANNUAL AND LONGITUDINAL VARIATIONS OF THE PACIFIC NORTH EQUATORIAL COUNTERCURRENT
Nina K. Lolk (California Univ., Los Angeles.) Mar. 1992 221 p
(Contract NAS7-918)
(NASA-CR-192805; NAS 1.26:192805; JPL-Publ-92-8) Avail: CASI HC A10/MF A03

The climatological annual cycle of the Pacific North Equatorial Countercurrent (NECC) simulated by an ocean general circulation model (OGCM) was studied. The longitudinal variation of transports, degree of geostrophy, and the relationship between Ekman pumping and vertical displacement of the thermocline were emphasized. The longitudinal variation was explored using six sections along 150 deg E, 180 deg, 160 deg W, 140 deg W, 125 deg W, and 110 deg W. A primitive equation OGCM of the Pacific Ocean was run for three years and the fields used were from the third year. The fields consisted of zonal, meridional, and vertical current components and temperature and salinity averaged every three days. The model was forced with the Hellerman and Rosenstein climatological wind stress. The mean annual eastward transport (19.9 Sv) was largest at 160 deg W. The maximum-current boundaries along 160 deg W were 9.2 deg N (1.0 deg), 5.1 deg N (1.1 deg), and 187 m (90.6 m). The annual-cycle amplitude of the NECC was greatest between 160 deg W and 140 deg W. Although the NECC is geostrophic to the first order, deviations from geostrophy were found in the boreal spring and summer near the southern boundary and near the surface. Meridional local acceleration played a role between 3 deg N-5 deg N. Author (revised)

N93-23475# Florida State Univ., Tallahassee. Geophysical Fluid Dynamics Inst.
STUDIES OF BAROCLINIC FLOW Final Report, 1 Oct. 1989 - 30 Sep. 1992
Richard L. Pfeffer Oct. 1992 30 p
(Grant AF-AFOSR-0009-90)
(AD-A259739; AFOSR-92-1020TR) Avail: CASI HC A03/MF A01

During the three years of this grant, nine papers were published or accepted for publication in peer-reviewed journals. They covered the following topics: (1) potential vorticity dynamics, (2) baroclinic instability in the presence of forcing, (3) baroclinic wave structure and transitions, (4) the role of mountains in the evolution of mid-latitude synoptic disturbances, (5) complex principle component analysis, and (6) numerical techniques versus nonlinear analytic methods. Abstracts of the papers are included. GRA

N93-23490 Cornell Univ., Ithaca, NY.
DIRECT NUMERICAL SIMULATIONS AND HYDRODYNAMIC STABILITY PROBLEMS IN THE UPPER OCEANIC MIXED LAYER Ph.D. Thesis
Amit Tandon 1992 142 p
Avail: Univ. Microfilms Order No. DA9300828

Langmuir circulations are longitudinal rolls driven by the wind and appear beneath the surface of the ocean. Following Craik and Leibovich, we model these as an instability of the mean current due to its interaction with averaged effect of the surface waves. Simulations and nonlinear dynamical analyses have previously been carried out with these rolls assumed to be independent of the downwind direction. We allow for perturbations in three dimensions for a layer of finite depth. Linear stability analysis shows that two-dimensional rolls are most unstable for unstratified flow as in previous two-dimensional studies. In presence of stratification three-dimensional modes are most unstable. At low and high values of the Reynolds number, the most unstable modes are nearly two-dimensional. At intermediate values, three dimensionality is important. The angular deviation from the wind direction of the most unstable modes increases with stratification, in the range considered. Two-dimensional simulations are done at different values of stratification for unconstrained and constrained sidewall boundary conditions. These show good agreement qualitatively and quantitatively with the weakly nonlinear dynamics of the governing equations in two-dimensions. We perform a secondary stability (Floquet) analysis to determine the range of stability of unstratified steady Langmuir rolls and elicit the streamwise length scales when rolls become unstable. Eckhaus and Oscillatory mechanisms of instability are found to be important at a moderate value of Reynolds number. Subsequent direct numerical simulations are performed for corresponding instabilities. Oscillatory instability sets in as streamwise traveling waves. As one of the destabilizing parameters is increased, quasi-periodic motion is observed, with a low frequency vacillating mode. At lower values of Reynolds number, the secondary instability thresholds for the forcing are higher and steady rolls are stable in a larger domain of parameter space. Simulations at high forcing at low Reynolds number show defect traveling wave solutions. The bifurcation to these solutions may be subcritical. Vacillating modes and defect solutions may be responsible for slow realignment of the windrows with time.
Dissert. Abstr.

N93-23636# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
A DIRECT MATHEMATICAL APPROACH TO OPTIMIZE THE AGE-DEPTH RELATION OF DEEP-SEA SEDIMENT CORES
Wolfgang Brueggemann Jan. 1992 43 p
(MPIM-77; ETN-93-93671) Avail: CASI HC A03/MF A01

A direct mathematical approach is used to find simultaneously an optimal age depth relation and a linear model that optimally links solar insolation or other model input with global ice volume. Thus, a general tool for the calibration of deep sea cores to arbitrary tuning targets is presented. In this inverse modeling type approach, an objective function is minimized that penalizes: the deviation of the data from the theoretical linear model (whose transfer function can be computed analytically for a given age depth relation), and the violation of a set of plausible assumptions about the model, the data and the obtained correction of a first guess age depth function. An unconstrained optimization problem is formulated that is solved numerically by conjugate gradient type methods. Using this direct approach, high coherencies are obtained in the Milankovitch frequency bands (over 90 percent). Not only the data time series, but also the derived correction to a first guess linear age depth function (and therefore the sedimentation rate) itself contains significant energy in a broad frequency band around 100 ky. The use of a sedimentation rate which varies continuously on ice age time scales results in a shift of energy from 100 ky in the original data spectrum to 41, 23 and 19 ky in the spectrum of the corrected data. However, a large proportion of the data variance remains unexplained, particularly in the 100 ky frequency band, where there is no significant input by orbital forcing. The method is applied to a real sediment core and to the SPECMAP stack, and results are compared with those obtained in earlier investigations. ESA

N93-23663# Washington Univ., Seattle. Applied Physics Lab.
REPORT OF THE SEA ICE THICKNESS WORKSHOP
A. S. Thorndike, C. Parkinson, and D. A. Rothrock Oct. 1992 170 p
Workshop held in New Carrollton, MD, 19-21 Nov. 1992
(AD-A259696) Avail: CASI HC A08/MF A02

The workshop emphasis was on the three questions: what is the current distribution of sea ice thickness?; what mechanical and thermal processes determine the thickness distribution?; and what are the techniques for measuring ice thickness? As understanding of these fundamental issues improves, so will our ability to address the many related topics. GRA

N93-23708# Army Topographic Engineering Center, Fort Belvoir, VA.
EVALUATION OF THE BATHYSCAN SWEEP SURVEY SYSTEM Technical Report, Sep. - Oct. 1990
Anthony Niles May 1992 34 p
(AD-A260162; TEC-0008) Avail: CASI HC A03/MF A01

The U.S. Army Corps of Engineers has an interest in hydrographic survey sweep systems, which produce depth soundings over the total bottom area. Such systems can have significant advantages, such as shorter survey times and more complete bottom representations, over the single-trace systems commonly used in the corps. Such a sweep system, the Bathyscan Hydrographic Survey System that uses interferometric side-scan sonar, was demonstrated to the corps. The Bathyscan proved to be a well-engineered and innovative design that would be well suited to corps reconnaissance surveys. Although the system was not survey ready due to some minor software problems and an error in an input parameter, the Bathyscan may be well-suited to condition and contract-payment surveys performed by the Corps. GRA

N93-23856# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
ORBITAL TUNING OF MARINE SEDIMENTARY CORES: AN AUTOMATIC PROCEDURE BASED ON A GENERAL LINEAR MODEL
Bjoern Grieger Jan. 1992 34 p
(MPIM-79; ETN-93-93673) Avail: CASI HC A03/MF A01

A method to optimize the chronology of marine cores by orbital tuning is presented. In a first step, and as an additional result, a model for the variation of the oxygen isotope abundance ratio throughout the core is calculated. The model consists of two components: one results from the convolution of the solar insolation at 65 deg on 15 Jul. with an impulse response function which is calculated from the data, the other is an additional low frequency component. The initial age depth relation of the core can be optimized by minimizing the deviation between model and data. The results of applications in the Meteor core 13519 and the Ocean Drilling Program core site 658 are shown. With the optimized chronologies the model fits the data quite well throughout the investigated cores. ESA

N93-23860# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
IRON FERTILIZATION OF THE AUSTRAL OCEAN: A MODEL ASSESSMENT
Katharina D. Kurz and Ernst Maier-Reimer May 1992 20 p
(MPIM-84; ETN-93-93678) Avail: CASI HC A03/MF A01

A proposal that an artificial iron fertilization could increase the productivity of the Antarctic Ocean and therefore reduce substantially the atmospheric carbon dioxide level is addressed. A set of experiments was performed with the three dimensional Hamburg global carbon cycle model to study the impact of such a fertilization. Under the assumption that only the magnitude but not the basic structure of the particulate downward flux is changed by the fertilization, the structure of the oceanic circulation is concluded to be able to support a higher remineralization as well as higher primary production. The reduction of the atmospheric content of carbon dioxide by the fertilization does not exceed 60 ppm. ESA

N93-23958# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
AIRBORNE STUDIES OF OCEAN-PARTICLE-CLOUD INTERACTIONS
4 Jan. 1993 6 p
(AD-A259874) Avail: CASI HC A02/MF A01

The objectives were to measure the lead signatures by remote sensing, measure emissions and fluxes from leads, determine effects of lead emissions of clouds, and to characterize arctic haze. Our approach was to fly over the pack ice, north of Deadhorse Alaska, detect leads with open water and conduct in situ measurements, sampling and remote sensing measurements. The measurements included determining the concentrations of droplets, ice crystals, and cloud condensation nuclei near leads. GRA

N93-23962 Oregon State Univ., Corvallis.
STUDIES OF MIXING AND INTERNAL WAVES IN THE UPPER OCEAN Ph.D. Thesis
Hemantha W. Wijesekera 1992 171 p
Avail: Univ. Microfilms Order No. DA9238070

Microstructure measurements in the equatorial Pacific at 140 deg W in late 1984 show a pronounced diurnal variation in both high-frequency internal wave energy and kinetic energy dissipation rate. Observations indicated that after sunset, internal waves propagate downward and increase turbulence levels in the pycnocline. A wave dissipation model based on the observed turbulent kinetic energy dissipation rate predicts that most of the downward wave momentum flux penetrates through the undercurrent core. It is hypothesized that when the wind stress is strong, the equatorial Pacific ocean responds by generating a westward travelling internal wave field which transports much of the surface wind stress below the actively mixing surface layer. Several models now exist for predicting the dissipation rate of turbulent kinetic energy, e, in the oceanic thermocline as a function of the large-scale properties of the internal gravity wave field. These models are based on the transfer of energy towards smaller vertical scales by wave-wave interactions, and their predictions are typically evaluated for a canonical internal wave field as described by Garrett and Munk. Here we use simultaneous measurements of the the internal wave field and e from a drifting ice camp in the eastern Arctic Ocean to evaluate the efficacy of existing models in a region with an anomalous wave field and energetic mixing. We find that, by explicitly retaining the vertical wavenumber bandwidth parameter, B*, models can still provide reasonable estimates of the dissipation rate. Statistics of turbulent patches are used to describe the nature of mixing in the pycnocline near abrupt bottom topography. It is found that the turbulent kinetic energy dissipation rate, e(sub r), averaged over a region of height r has a lognormal distribution consistent with Kolomorov's third hypothesis: sigma-squared(sub ln(e sub r)) = A + mu ln(L sub p / r) where sigma-squared(sub ln)(e sub r) is the variance of ln(e sub r), r satisfies L sub p greater than r greater than nu (L sub p is the size of the mixing patch, nu is the Kolmogorov scale, A depends on the large-scale flow field, and mu is a universal constant). The majority of the observed turbulent patches may be explained with the conventional ideas of shear-driven turbulence. However, some events with large overturning structures are substantially different from the predictions of shear-driven turbulence, suggesting that there is at least one source of turbulent kinetic energy other than shear production. Based on inertial-subrange energy arguments, it is proposed that the overturning seen in these events is a release of potential energy to kinetic energy, such as might be expected from advective instability in a finite-amplitude internals wave field. Dissert. Abstr.

N93-23979# Pacific Northwest Lab., Richland, WA.
AN AUTONOMOUS EXPENDABLE CONDUCTIVITY, TEMPERATURE, DEPTH PROFILER FOR OCEAN DATA COLLECTION
J. Downing (Battelle Pacific Northwest Labs., Sequim, WA.), B. G. DeRoos (Battelle Memorial Inst., Columbus, OH.), and K. McCoy (Ocean Sensors, Inc., San Diego, CA.) Oct. 1992 7 p Presented at the Oceans 1992, Newport, RI, 26-29 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-005038; PNL-SA-21225; CONF-921066-2) Avail: CASI HC A02/MF A01

An Autonomous Expendable Conductivity - Temperature - Depth Profiler (AXCTD) for profiling temperature, conductivity, pressure, and other parameters in remote oceanic regions is described. The AXCTD is a microcomputer-controlled sensor package that can be deployed by unskilled operators from ships or aircraft. It records two CTD profiles (one during descent and another during ascent) and CTD times series while on the bottom and adrift at the surface. Recorded data are transmitted to an ARGOS satellite with ground-positioning capabilities. The AXCTD can provide 'sea truth' for remote sensing, perform environmental and military surveillance missions, and acquire time-series and synoptic data for computer models. DOE

N93-24026# Massachusetts Inst. of Tech., Cambridge. Electronics Research Lab.
ACTIVE AND PASSIVE REMOTE SENSING OF ICE Final Report, 1 Oct. 1988 - 30 Nov. 1992
J. A. Kong 26 Jan. 1993 73 p
(Contract N00014-89-J-1107)
(AD-A259765) Avail: CASI HC A04/MF A01

The theoretical approach that has been developed to interpret the polarimetric active measurements of saline ice is a random medium model using the radiative transfer theory. The ice layer is described as a host ice medium embedded with randomly distributed inhomogeneities, and the underlying sea water is considered to be a homogeneous halfspace. Multiple scattering effects are accounted for by solving the radiative transfer equations numerically. The effects of random roughness at the air - ice, and ice -

water interfaces are accounted for by modifying the boundary conditions in the radiative transfer equations. Analysis of the model for reconstruction of sea ice parameters is made. An optimization approach is used for inversion. The discrepancy between the data and the results of the forward model is minimized by changing the inversion parameters according to a nonlinear programming scheme. Reconstruction of correlation lengths in the horizontal and vertical dimensions was accomplished using the polarimetric backscattering coefficients at different angles of incidence as input data. Effects of data diversity and noise on the reconstruction of the physical parameters of sea ice from the backscattering coefficients are being investigated. GRA

N93-24091# Norwegian Defence Research Establishment, Kjeller.
ON THE PHYSICAL BOUNDARY CONDITIONS IN THE OCEAN/BOTTOM ACOUSTIC INTERACTION MODEL
Ivar Lie 23 Jul. 1992 21 p
(FFI-92/7023; ETN-93-93571) Avail: CASI HC A03/MF A01

An extension to a model for acoustic bottom interaction problems is reported. This model uses interface conditions between the different media based on continuous normal velocity and continuous normal stress. The model was extended to include continuity in tangential velocity and damping at the interface. Numerical experiments show that these extended models are time stable. The use of the equations of viscoelasticity in the bottom medium and application of the equations of a fluid saturated porous medium are discussed. ESA

N93-24099# Naval Postgraduate School, Monterey, CA.
MODELING THE TROPICAL OCEAN RESPONSE TO WESTERLY WIND FORCING M.S. Thesis
Claudia S. Whitney Dec. 1992 133 p
(AD-A260230) Avail: CASI HC A07/MF A02

A primitive equation ocean general circulation model, with mixed layer physics, was developed and applied to an investigation of the equatorial ocean. The major physical problem addressed with this model is the response of the upper ocean to westerly wind events, such as those that occur during tropical cyclones and during El Nino events. In the model development phase, several configurations of the mixed layer physics, domain size, and wind stress were tested. The best overall simulations were produced when both Richardson number-dependent mixing and a bulk mixed layer model were included. Small model domains were found to be especially sensitive to the prescribed lateral boundary conditions and wind stress. Smaller domains required more realistic wind stress fields in order to achieve reasonable current structures. In addition, the off-equatorial currents were particularly responsive to changes in the zonal gradient of the wind stress. The final configuration of the model produces realistic simulations of climatological three-dimensional temperature and current structures in the equatorial ocean. In the model application phase, synoptically varying winds for the tropical Pacific were used to force the model. The winds came from the Navy's Operational Global Atmospheric Prediction System's (NOGAPS) daily analyses for the 1991-92 El Nino, which included several strong westerly wind events. The strong temporal and spatial variability in these winds produced complex fluctuations of the model's temperatures, currents, and internal waves, including reversals of the South Equatorial Current and equatorially trapped Kelvin waves. GRA

N93-24144# Delaware Univ., Newark.
OCEAN GOVERNANCE: A NEW VISION
Biliana Cicin-Sain Dec. 1992 69 p Sponsored by National Grant College Program, Silver Spring, MD
(PB93-136299; DEL-SG-17-92) Avail: CASI HC A04/MF A01

The following topics are discussed: research agenda on ocean governance; implications of the earth summit for ocean and coastal governance; since the Stratton Commission report: policy studies in ocean governance, 1969 and 1992; substantive principles for a constitution for the U.S. oceans; lessons for ocean governance from History, Ecology, and Economics; indigenous conceptions of stewardship; learning from other nations; the changing international regime; implications for U.S. ocean management, organization, and approaches; caveats on 'integration' in ocean and coastal management; ocean and coastal management in the United States; the need to incorporate local, state, and regional perspectives; on the practical challenges of improving ocean governance; some illustrations from Louisiana; assessing cumulative impacts; and free trade and ocean governance. GRA

N93-24178 Stevens Inst. of Tech., Hoboken, NJ.
NUMERICAL SIMULATION AND PREDICTION OF COASTAL OCEAN CIRCULATION Ph.D. Thesis
Ping Chen 1992 249 p
Avail: Univ. Microfilms Order No. DA9227872

Numerical simulation and prediction of coastal ocean circulation have been conducted in three cases. (1) A process-oriented modeling study is conducted to study the interaction of a western boundary current (WBC) with coastal water, and its responses to upstream topographic irregularities. We hypothesize that the interaction of propagating WBC frontal waves and topographic Rossby waves are responsible for upstream variability. The model contains a spun-up WBC, a continental slope/shelf and topographic irregularity (island blocking and seamounts of various sizes). It is found that these topographic irregularities are origins of topographic waves which propagate southward, and that flow variabilities, including large amplitude meanders and shelfward intrusions, occur at upstream distances which coincide approximately with topographic standing wavelength due to the superposition of frontal waves and topographic waves. (2) A simulation of meanders and eddies in the Norwegian Coastal Current (NCC) for February and March of 1988 is conducted with a newly developed nested dynamic interactive model. The model employs a coarse-grid, large domain to account for non-local forcing and a fine-grid nested domain to resolve meanders and eddies. The model is forced by wind stresses, heat fluxes and atmospheric pressure corresponding Feb/Mar of 1988, and accounts for river/fjord discharges, open ocean inflow and outflow, and M2 tides. The simulation reproduced fairly well the observed circulation, tides, and salinity features in the North Sea, Norwegian Trench and NCC region in the large domain, and fairly realistic meanders and eddies in the NCC in the nested region. (3) A methodology for practical coastal ocean hindcast/forecast is developed, taking advantage of the disparate time scales of various forcing and considering wind to be the dominant factor in affecting density fluctuation in the time scale of 1 to 10 days. The density field obtained from a prognostic simulation is analyzed by the empirical orthogonal function method (EOF), and correlated with the wind; these information are then used to drive a circulation model which excludes the density calculation. The method is applied to hindcast the circulation in the New York Bight for spring and summer season of 1988. The hindcast fields compare favorably with the results obtained from the prognostic circulation model. Dissert. Abstr.

N93-24581# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
APPLICATION OF OCEAN MODELS FOR THE INTERPRETATION OF AGCM EXPERIMENTS ON THE CLIMATE OF THE LAST GLACIAL MAXIMUM
Michael Lautenschlager (Deutsches Klimarechenzentrum G.m.b.H., Hamburg, Germany.), Uwe Mikolajewicz, Ernst Maier-Reimer, and Christophe Heinze (Hamburg Univ., Germany.) 23 Mar. 1992 23 p Sponsored by BMFT
(MPIM-80; ETN-93-93674) Avail: CASI HC A03/MF A01

The response of ocean models of physical circulation and geochemical tracer distributions to atmospheric glacial forcing is examined. The CLIMAP Sea Surface Temperature (SST) was taken directly as a boundary condition. The windstress and freshwater flux were derived from the ice age response of an Atmospheric General Circulation Model (AGCM). Near the surface, the ocean response in temperature and circulation reflects primarily the imposed glacial forcing fields. The simulated deep ocean response, especially in the North Pacific, is in conflict with the observational evidence. The changes in the physical circulation appear to be qualitatively derived from sediment cores, but, probably, highly overestimated. The misfit between model and data was established more clearly in the distribution of (delta)C-13, where a direct comparison with sediment core data is possible. The simulated AGCM freshwater flux, which is linked for example by the evaporation to the imposed SST field, is suspected to be the most probable reason for this conflict. ESA

N93-24605# Geo-Marine, Inc., Plano, TX.
PROCEEDINGS OF THE 12TH ANNUAL GULF OF MEXICO INFORMATION TRANSFER MEETING Final Report
Dec. 1992 551 p Meeting held in New Orleans, LA, 5-7 Nov. 1991
(Contract DI-14-35-0001-30499)
(PB93-152031; OCS/MMS-92/0027) Avail: CASI HC A24/MF A04

The volume summarizes the presentations given at the Twelfth Annual Gulf of Mexico ITM held in November 1991. Session topics included opening plenary; decision making; Minerals Management Service Environmental Studies Program progress reports; scoping socioeconomic concerns and issues in the Gulf of Mexico region; development potential of hard mineral resources in the exclusive economic zone of the northern Gulf of Mexico produced water: disposal technologies/regulations; oil spills response; social and economic studies and issues of the Sea Grant college program--a national perspective and Gulf of Mexico regional initiatives; Minerals Management Service/Louisiana Universities Marine Consortium University Research Initiative; monitoring, assessment, and prevention of marine debris on gulf beaches. GRA

N93-23825# Southampton Univ. (England). Dept. of Oceanography.
COMPUTER-BASED LESSONS IN SATELLITE OCEANOGRAPHY: AN ACADEMIC NETWORK FOR TEACHERS AND STUDENTS
Ian S. Robinson, David Blackburn (Bureau International des Poids et Mesures, Sevres, France.), Richard Callison (Pharos Scientific Ltd., Dundee, Scotland.), and Dirk G. Troost (United Nations Educational, Scientific and Cultural Organization, Paris, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1331-1336 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

51 LIFE SCIENCES (GENERAL)

N93-22800*# California Univ., Berkeley. Interdisciplinary Studies Center.
MICROMOTIONAL STUDIES OF UTRICULAR AND CANAL AFFERENTS Final Technical Report, 1 Jan. 1987 - 31 Dec. 1989
Edwin R. Lewis 31 Dec. 1989 4 p
(Grant NAG2-448)
(NASA-CR-192703; NAS 1.26:192703) Avail: CASI HC A01/MF A01

The long-range goal of this research was to refine our understanding of the sensitivity of the vestibular components of the ear to very-low-amplitude motion, especially, the role of gravity in this sensitivity. We focused on the American bullfrog--a common animal subject for vestibular sensory research. Our principal experimental method was to apply precise, sinusoidal microrotational stimuli to an anesthetized animal subject, to record the resulting responses in an individual vestibular nerve fiber from the intact ear, and to use intracellular dye to trace the fiber and thus identify the vestibular sensor that gave rise to it. In this way, we were able to identify specific micromotional sensitivities and to associate those sensitivities definitely with specific sensors. Furthermore, by recording from nerve fibers after they leave the intact inner-ear cavity, we were able to achieve these identifications without interrupting the delicate micromechanics of the inner ear. We were especially concerned with the relative roles of the utricle and the anterior semicircular canal in the sensing of microrotational motion of the head about horizontal axes, and with the role of gravity in mediating that sensing process in the utricle. The functional characterization of individual nerve fibers was accomplished with a conventional analytical tool, the cycle histogram, in which the nerve impulse rate was plotted against the phase of the sinusoidal stimulus. Author

N93-22913# Southwest Research Inst., San Antonio, TX.
EFFECTS OF 60-Hz ELECTRIC AND MAGNETIC FIELDS ON OPERANT AND SOCIAL BEHAVIOR AND ON NEUROENDOCTRINE SYSTEM OF NONHUMAN PRIMATES
W. R. Rogers 22 Jan. 1993 11 p
(Contract DE-AC02-80RA-50219)
(DE93-007677; DOE/RA-50219/T27) Avail: CASI HC A03/MF A01

This series of experiments, using a well-characterized exposure facility and employing a variety of control procedures to study behavior and the neuroendoctrine system of nonhuman primates, does not provide any evidence that exposure to power-frequency electric fields, or electric and magnetic fields in combination, for 12 hours per day for six weeks produces any deleterious effects in young-adult males. The primate experiments summarized here confirm the general conclusion indicated by experiments with rodents; although biological and behavioral changes can occur, there are no clear results establishing the occurrence of adverse effects in experiments involving relatively short-term exposure to environmentally-relevant electric or magnetic fields. Given the general agreement of the primate and rodent results, conclusions from the laboratory animal studies therefore presumably generalize well to humans. DOE

N93-23068*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE. TRADE STUDIES, VOLUME 1
1 Jun. 1989 395 p Sponsored by NASA. Johnson Space Center
(NASA-CR-190989; NAS 1.26:190989) Avail: CASI HC A17/MF A04

The six studies which are addressed are entitled: Design Modularity and Commonality; Modification of Existing Hardware (COTS) vs. New Hardware Build Cost Analysis; Automation Cost vs. Crew Utilization; Hardware Miniaturization versus Cost; Space Station Freedom/Spacelab Modules Compatibility vs. Cost; and Prototype Utilization in the Development of Space Hardware. The product of these six studies was intended to provide a knowledge base and methodology that enables equipment produced for the Space Biology Initiative program to meet specific design and functional requirements in the most efficient and cost effective form consistent with overall mission integration parameters. Each study promulgates rules of thumb, formulas, and matrices that serves has a handbook for the use and guidance of designers and engineers in design, development, and procurement of Space Biology Initiative (SBI) hardware and software. For individual titles, see N93-23069 through N93-23071.

N93-23069*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 5: MODIFICATION OF EXISTING HARDWARE (COTS) VERSUS NEW HARDWARE BUILD COST ANALYSIS Final Report
L. Neal Jackson, John Crenshaw, Sr., William L. Davidson (Eagle Engineering, Inc., Houston, TX.), Carolyn Blacknall (Eagle Engineering, Inc., Houston, TX.), James W. Bilodeau (Eagle Engineering, Inc., Houston, TX.), J. Michael Stoval (Eagle Engineering, Inc., Houston, TX.), and Terry Sutton (Eagle Technical Services, Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 1 1 Jun. 1989 120 p Prepared in cooperation with General Electric Co., Houston, TX (For primary document see N93-23068 08-51)
(Contract G966016-J45)
Avail: CASI HC A06/MF A04

The JSC Life Sciences Project Division has been directly supporting NASA Headquarters, Life Sciences Division, in the preparation of data from JSC and ARC to assist in defining the Space Biology Initiative (SBI). GE Government Services and Horizon Aerospace have provided contract support for the development and integration of review data, reports, presentations, and detailed supporting data. An SBI Definition (Non-Advocate) Review at NASA Headquarters, Code B, has been scheduled for the June-July 1989 time period. In a previous NASA Headquarters review, NASA determined that additional supporting data would be beneficial to determine the potential advantages in modifying commercial off-the-shelf (COTS) hardware for some SBI hardware items. In order to meet the demands of program implementation planning with the definition review in late spring of 1989, the definition trade study analysis must be adjusted in scope and schedule to be complete for the SBI Definition (Non-Advocate) Review. The relative costs of modifying existing commercial off-the-shelf (COTS) hardware is compared to fabricating new hardware. An historical basis for new build versus modifying COTS to meet current NMI specifications for manned space flight hardware is surveyed and identified. Selected SBI hardware are identified as potential candidates for off-the-shelf modification and statistical estimates on the relative cost of modifying COTS versus new build are provided. Author (revised)

N93-23070*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 1: AUTOMATION COSTS VERSUS CREW UTILIZATION Final Report
L. Neal Jackson, John Crenshaw, Sr., R. N. Hambright (Southwest Research Inst., Houston, TX.), A. Nedungadi (Southwest Research Inst., Houston, TX.), G. M. McFayden (Southwest Research Inst., Houston, TX.), and M. S. Tsuchida (Southwest Research Inst., Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 1 1 Jun. 1989 91 p Prepared

in cooperation with General Electric Co., Houston, TX (For primary document see N93-23068 08-51)
(Contract G966016-J45)
Avail: CASI HC A05/MF A04

A significant emphasis upon automation within the Space Biology Initiative hardware appears justified in order to conserve crew labor and crew training effort. Two generic forms of automation were identified: automation of data and information handling and decision making, and the automation of material handling, transfer, and processing. The use of automatic data acquisition, expert systems, robots, and machine vision will increase the volume of experiments and quality of results. The automation described may also influence efforts to miniaturize and modularize the large array of SBI hardware identified to date. The cost and benefit model developed appears to be a useful guideline for SBI equipment specifiers and designers. Additional refinements would enhance the validity of the model. Two NASA automation pilot programs, 'The Principal Investigator in a Box' and 'Rack Mounted Robots' were investigated and found to be quite appropriate for adaptation to the SBI program. There are other in-house NASA efforts that provide technology that may be appropriate for the SBI program. Important data is believed to exist in advanced medical labs throughout the U.S., Japan, and Europe. The information and data processing in medical analysis equipment is highly automated and future trends reveal continued progress in this area. However, automation of material handling and processing has progressed in a limited manner because the medical labs are not affected by the power and space constraints that Space Station medical equipment is faced with. Therefore, NASA's major emphasis in automation will require a lead effort in the automation of material handling to achieve optimal crew utilization. Author (revised)

N93-23071*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 4: DESIGN MODULARITY AND COMMONALITY Final Report
L. Neal Jackson, John Crenshaw, Sr., William L. Davidson (Eagle Engineering, Inc., Houston, TX.), Frank J. Herbert (Eagle Engineering, Inc., Houston, TX.), James W. Bilodeau (Eagle Engineering, Inc., Houston, TX.), J. Michael Stoval (Eagle Engineering, Inc., Houston, TX.), and Terry Sutton (Eagle Technical Services, Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 1 1 Jun. 1989 141 p Prepared in cooperation with General Electric Co., Houston, TX (For primary document see N93-23068 08-51)
(Contract G966016-J45)
Avail: CASI HC A07/MF A04

The relative cost impacts (up or down) of developing Space Biology hardware using design modularity and commonality is studied. Recommendations for how the hardware development should be accomplished to meet optimum design modularity requirements for Life Science investigation hardware will be provided. In addition, the relative cost impacts of implementing commonality of hardware for all Space Biology hardware are defined. Cost analysis and supporting recommendations for levels of modularity and commonality are presented. A mathematical or statistical cost analysis method with the capability to support development of production design modularity and commonality impacts to parametric cost analysis is provided. Author (revised)

N93-23079*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE. TRADE STUDIES, VOLUME 2
1 Jun. 1989 366 p Sponsored by NASA. Johnson Space Center
(NASA-CR-190990; NAS 1.26:190990) Avail: CASI HC A16/MF A03

The six studies which are the subjects of this report are entitled: Design Modularity and Commonality; Modification of Existing Hardware (COTS) vs. New Hardware Build Cost Analysis; Automation Cost vs. Crew Utilization; Hardware Miniaturization versus Cost; Space Station Freedom/Spacelab Modules Compatibility vs. Cost; and Prototype Utilization in the Development of Space Hardware. The product of these six studies was intended to provide a knowledge base and methodology that enables equipment produced for the Space Biology Initiative program to meet specific design and functional requirements in the most efficient and cost effective form consistent with overall mission integration parameters. Each study promulgates rules of thumb, formulas, and matrices that serves as a handbook for the use and guidance of designers and engineers in design, development, and procurement of Space Biology Initiative (SBI) hardware and software. For individual titles, see N93-23080 through N93-23082.

N93-23080*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 3: HARDWARE MINIATURIZATION VERSUS COST Final Report
L. Neal Jackson, John Crenshaw, Sr., William L. Davidson (Eagle Engineering, Inc., Houston, TX.), Frank J. Herbert (Eagle Engineering, Inc., Houston, TX.), James W. Bilodeau (Eagle Engineering, Inc., Houston, TX.), J. Michael Stoval (Eagle Engineering, Inc., Houston, TX.), and Terry Sutton (Eagle Technical Services, Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 2 1 Jun. 1989 133 p Prepared for General Electric Co., Houston, TX (For primary document see N93-23079 08-51)
(Contract G966016-J45)
Avail: CASI HC A07/MF A03

The optimum hardware miniaturization level with the lowest cost impact for space biology hardware was determined. Space biology hardware and/or components/subassemblies/assemblies which are the most likely candidates for application of miniaturization are to be defined and relative cost impacts of such miniaturization are to be analyzed. A mathematical or statistical analysis method with the capability to support development of parametric cost analysis impacts for levels of production design miniaturization are provided. Author (revised)

N93-23081*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 6: SPACE STATION FREEDOM/SPACELAB MODULES COMPATIBILITY Final Report
L. Neal Jackson, John Crenshaw, Sr., William L. Davidson (Eagle Engineering, Inc., Houston, TX.), Carolyn Blacknall (Eagle Engineering, Inc., Houston, TX.), James W. Bilodeau (Eagle Engineering, Inc., Houston, TX.), J. Michael Stoval (Eagle Engineering, Inc., Houston, TX.), and Terry Sutton (Eagle Technical Services, Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 2 1 Jun. 1989 122 p Prepared in cooperation with General Electric Co., Houston, TX (For primary document see N93-23079 08-51)
(Contract G966016-J45; HAG Order 966016-J45-EAGLE)
(EEI-89-236) Avail: CASI HC A06/MF A03

The differences in rack requirements for Spacelab, the Shuttle Orbiter, and the United States (U.S.) laboratory module, European Space Agency (ESA) Columbus module, and the Japanese Experiment Module (JEM) of Space Station Freedom are identified. The feasibility of designing standardized mechanical, structural, electrical, data, video, thermal, and fluid interfaces to allow space flight hardware designed for use in the U.S. laboratory module to be used in other locations is assessed.
Author (revised)

N93-23082*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 2: PROTOTYPE UTILIZATION IN THE DEVELOPMENT OF SPACE BIOLOGY HARDWARE Final Report
L. Neal Jackson, John Crenshaw, Sr., Arthur E. Schulze (Lovelace Scientific Resources, Inc., Albuquerque, NM.), and H. J. Wood, Jr. (Lovelace Scientific Resources, Inc., Albuquerque, NM.) *In its* Space Biology Initiative. Trade Studies, Volume 2 1 Jun. 1989 101 p Prepared in cooperation with Lovelace Scientific Resources, Inc., Albuquerque, NM (For primary document see N93-23079 08-51)
(Contract G966016-J45)
Avail: CASI HC A06/MF A03

The objective was to define the factors which space flight hardware developers and planners should consider when determining: (1) the number of hardware units required to support program; (2) design level of the units; and (3) most efficient means of utilization of the units. The analysis considered technology risk, maintainability, reliability, and safety design requirements for achieving the delivery of highest quality flight hardware. Relative cost impacts of the utilization of prototyping were identified. The development of Space Biology Initiative research hardware will involve intertwined hardware/software activities. Experience has shown that software development can be an expensive portion of a system design program. While software prototyping could imply the development of a significantly different end item, an operational system prototype must be considered to be a combination of software and hardware. Hundreds of factors were identified that could be considered in determining the quantity and types of prototypes that should be constructed. In developing the decision models, these factors were combined and reduced by approximately ten-to-one in

order to develop a manageable structure based on the major determining factors. The Baseline SBI hardware list of Appendix D was examined and reviewed in detail; however, from the facts available it was impossible to identify the exact types and quantities of prototypes required for each of these items. Although the factors that must be considered could be enumerated for each of these pieces of equipment, the exact status and state of development of the equipment is variable and uncertain at this time. Derived from text

N93-23169*# Alabama A & M Univ., Normal. Dept. of Plant and Soil Science.

A PROPOSAL TO DEMONSTRATE PRODUCTION OF SALAD CROPS IN THE SPACE STATION MOCKUP FACILITY WITH PARTICULAR ATTENTION TO SPACE, ENERGY, AND LABOR CONSTRAINTS Final Report, 1 Jul. - 31 Dec. 1992

Carolyn A. Brooks 31 Dec. 1992 36 p

(Contract NCC2-607)

(NASA-CR-192815; NAS 1.26:192815) Avail: CASI HC A03/MF A01

The Salad Machine Research has continued to be a two path effort with the research at Marshall Space Flight Center (MSFC) focusing on the design, construction, and operation of a semiautomated system (Salad Machine) for the production of salad vegetables within a standard rack. Boeing Corporation in cooperation with NASA MSFC constructed a four drawer Salad Machine which was occasionally placed within the Space Station Freedom Mockup facility for view by selected visitors. Final outfitting of the Salad Machine is awaiting the arrival of parts for the nutrient delivery system. Research at the Alabama A&M facilities focused on compatibility of radish and lettuce plants when grown on the same nutrient solution. Lettuce fresh weight shoot yield was significantly enhanced when lettuce plants were grown on nutrient solution which was shared with radish. Radish tuber production was not significantly affected although there was a trend for radish from shared solutions to be heavier than those grown on separate nutrient solutions. The effect of sharing nutrient solutions on carbohydrate partitioning reflected the effect of sharing solution on fresh weight yield. Lettuce shoot dry weight was significantly greater for plants from shared solutions than from separate. There was no significant effect on sharing nutrient solution on radish tuber dry weight. Partitioning of nitrogen, calcium, magnesium, and potassium was not affected by sharing, there was, however, a disproportionate amount of potassium in the tissues, suggesting luxury consumption of potassium in all plants and tissues. It is concluded that lettuce plants benefit from sharing nutrient solution with radish and that radish is not harmed. Author (revised)

N93-23233*# Eye and Ear Hospital, Pittsburgh, PA.

NEURAL PROCESSING OF GRAVITY INFORMATION Final Technical Report, 1 Nov. 1987 - 30 Jun. 1992

Robert H. Schor 30 Jun. 1992 3 p

(Contract NCC2-495)

(NASA-CR-192766; NAS 1.26:192766) Avail: CASI HC A01/MF A01

The goal of this project was to use the linear acceleration capabilities of the NASA Vestibular Research Facility (VRF) at Ames Research Center to directly examine encoding of linear accelerations in the vestibular system of the cat. Most previous studies, including my own, have utilized tilt stimuli, which at very low frequencies (e.g., 'static tilt') can be considered a reasonably pure linear acceleration (e.g., 'down'); however, higher frequencies of tilt, necessary for understanding the dynamic processing of linear acceleration information, necessarily involves rotations which can stimulate the semicircular canals. The VRF, particularly the Long Linear Sled, has promise to provide controlled pure linear accelerations at a variety of stimulus frequencies, with no confounding angular motion. Author (revised)

N93-23343# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).

BIBLIOGRAPHY OF THE BIOSCIENCES DIVISION: 1986 TO PRESENT

Kenneth N. Ackles, comp. and ed. Mar. 1992 163 p

(DCIEM-92-20; CTN-93-60696) Avail: CASI HC A08/MF A02

About 330 publications are listed in a bibliography of the work of the Biosciences Division of Canada's Defence and Civil Institute of Environmental Medicine. Papers are arranged by year of publication (1986-1992) and then by author within the following categories: operational medicine, aerospace life sciences, physical performance and thermal stress, impact protection, diving, and robotic technology. An index of authors is included. CISTI

N93-23369# Technical Research Centre of Finland, Espoo. Biotechnical Lab.

BIOTECHNICAL PRODUCTION AND USE OF PYRUVIC ACID WITH SPECIAL REFERENCE TO COENZYME REGENERATION Ph.D. Thesis - Helsinki Univ.

Hanna-Leena Livio Apr. 1991 102 p

(VTT-Pubs-77; ISBN-951-38-3946-X; ETN-93-93480) Copyright Avail: CASI HC A06/MF A02

The enhancement of pyruvic acid secretion by Candida utilis IFO 0396 was studied with reference to coenzyme regeneration and metabolic modifications. The coenzyme dependent conversion of pyruvate to L-alanine was investigated with immobilized and free enzymes. The aim was to improve pyruvic acid production by Candida utilis by clarifying the metabolic responses to high substrate concentrations and to nitrogen source as well as the role of aeration in the redox balance. Various intracellular modifiers were examined in order to shift the metabolic activity of the yeast towards pyruvic acid overproduction. Pyruvic acid was used for amino acid production with the specific aims of investigating the coupled enzyme system in coenzyme regeneration and comparing the possibilities of different enzyme immobilization methods. ESA

N93-24028# Argonne National Lab., IL.

NONLINEAR OPTICAL PROPERTIES OF PORPHYRIN AND CHLOROPHYLL DIMERS STUDIED BY DEGENERATED FOUR WAVE MIXING

L. X. Q. Chen 1992 5 p Presented at the International Society for Optical Engineering (SPIE) Conference, Los Angeles, CA, 16-23 Jan. 1993

(Contract W-31-109-eng-38)

(DE93-006411; ANL/CHM/CP-78537; CONF-930159-3) Avail: CASI HC A01/MF A01

As one of the important elements in natural and artificial electron transfer and energy transfer processes, porphyrin and its derivatives have received much attention in photoelectronics and photoelectronic materials. As our first attempt to relate the pi-pi electronic couplings between porphyrin macrocycles to apparent third order nonlinear susceptibilities, we measured chi(sup 3) for several porphyrin and chlorophyll a derivatives, including dimers with different configurations. Our preliminary results show that the dimers have enhanced chi(sup 3) compared to those of the monomer. This enhancement is related to the relative orientations between the two macrocycles in the dimers. The parallel dimers with close face-to-face distances seem to have the highest enhancement in chi(sup 3). Thus, we believe that chi(sup 3) is strongly related to the pi-pi electronic coupling between the two conjugated ring systems. DOE

N93-24455# Southwest Research Inst., San Antonio, TX. Dept. of Biosciences and Bioengineering.

INVESTIGATION OF EFFECTS OF 60-Hz ELECTRIC AND MAGNETIC FIELDS ON OPERANT AND SOCIAL BEHAVIOR AND ON THE NEUROENDOCRINE SYSTEM OF NONHUMAN PRIMATES

H. Smith 22 Jan. 1993 288 p

(Contract DE-AC02-80RA-50219)

(DE93-007678; DOE/RA-50219/T28) Avail: CASI HC A13/MF A03

The objective of this program is to investigate behavioral and neuroendocrine effects associated with exposure to 60-Hz electric and magnetic fields (E/MF), using the baboon (Papio cynocephalus) as a nonhuman primate surrogate for the human. Results from this program, along with information from experiments conducted elsewhere, could be used to estimate and evaluate the likelihood of deleterious consequences of human exposure to the electric and magnetic fields associated with electric power transmission. DOE

N93-22622*# National Aeronautics and Space Administration, Washington, DC.

LIFE SCIENCES UTILIZATION OF SPACE STATION FREEDOM

Lawrence P. Chambers *In its* Space Station Freedom Utilization Conference 1992 p 211-220 (For primary document see N93-22606 08-18)

Avail: CASI HC A02/MF A04

N93-22623*# National Aeronautics and Space Administration, Washington, DC.
LIFE SCIENCES RECRUITMENT OBJECTIVES
J. Richard Keefe *In its* Space Station Freedom Utilization Conference 1992 p 221-233 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

N93-22624*# National Aeronautics and Space Administration, Washington, DC.
BIOMEDICAL MONITORING AND COUNTERMEASURES FACILITY
Donald F. Stewart *In its* Space Station Freedom Utilization Conference 1992 p 235-249 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

N93-22625*# General Electric Co., Huntsville, AL. Government Services.
GRAVITATIONAL BIOLOGY FACILITY ON SPACE STATION: MEETING THE NEEDS OF SPACE BIOLOGY
Katherine Allen and Charles Wade *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 251-259 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

N93-22629*# Omega Aerospace, Inc., Virginia Beach, VA.
AN ON-ORBIT VIEWPOINT OF LIFE SCIENCES RESEARCH Abstract Only
Byron K. Lichtenberg *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 291 (For primary document see N93-22606 08-18)
Avail: CASI HC A01/MF A04

N93-22649*# Pennsylvania State Univ., University Park. Center for Cell Research.
COMMERCIAL OPPORTUNITIES IN BIOSEPARATIONS AND PHYSIOLOGICAL TESTING ABOARD SPACE STATION FREEDOM
W. C. Hymer *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 553-566 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

N93-22651*# Alabama Univ., Huntsville. Consortium for Materials Development in Space.
MATERIALS DISPERSION AND BIODYNAMICS PROJECT RESEARCH
Marian L. Lewis *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 575-588 (For primary document see N93-22606 08-18)
Avail: CASI HC A03/MF A04

N93-24379# Trondheim Univ. (Norway).
THE USO-CONCEPT APPLIED TO A BIOLOGICAL MODEL EXPERIMENT
T.-H. Iversen, E. B. Skagen, C. Baggerud, T. Beisvaag, O. S. Rasmussen (Aarhus Univ., Denmark.), T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), H. T. Blume (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), and H. Duwe (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 241-244 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24401# Ruhr Univ., Bochum (Germany). Comparative Endocrinology Research Section.
CEBAS-AQUARACK: AN ARTIFICIAL AQUATIC ANIMAL PLANT ECOSYSTEM AS A TOOL FOR BASIC RESEARCH IN THE COLUMBUS SPACE STATION
V. Bluem, K. Kreuzberg (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), and E. Stretzke *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 359-364 Sponsored by Ministry of Science and Research (For primary document see N93-24336 08-12)
(Contract BMFT-50-QV-8846)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24402# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
JAPANESE TREEFROG EXPERIMENT ONBOARD THE SPACE STATION MIR
Masamichi Yamashita and Akemi Izumi-Kurotani *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 365-369 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24403# Paris VI Univ. (France).
GRAVITY AND ROOT MORPHOGENESIS
G. Perbal and D. Driss-Ecole *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 371-377 Sponsored by CNES (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24404# Nottingham Univ. (England). Dept. of Life Science.
DEVELOPMENT OF ARABIDOPSIS THALIANA GROWN UNDER MICROGRAVITY CONDITIONS
L. G. Briarty and E. P. Maher (Open Univ., Scotland.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 379-384 Sponsored by United Kingdom Science and Engineering Research Council and Nottingham Univ. National Westminster Bank Research Fund (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N93-22655*# General Dynamics Corp., San Diego, CA. Space Systems Div.
CANDIDATE TECHNOLOGIES FOR THE INTEGRATED HEALTH MANAGEMENT PROGRAM Final Report, 30 Oct. 1992 - 26 Feb. 1993
Neal F. Johnson and Fred H. Martin 26 Feb. 1993 16 p
(NASA Order H-18763-D)
(NASA-CR-192339; NAS 1.26:192339; Rept-93H-C-006) Avail: CASI HC A03/MF A01

The purpose of this report is to assess Vehicle Health Management (VHM) technologies for implementation as a demonstration. Extensive studies have been performed to determine technologies which could be implemented on the Atlas and Centaur vehicles as part of a bridging program. This paper discusses areas today where VHM can be implemented for benefits in reliability, performance, and cost reduction. VHM Options are identified and one demonstration is recommended for execution. Derived from text

N93-22774# Los Alamos National Lab., NM.
ADAPTIVE FILTERS FOR MONITORING LOCALIZED BRAIN ACTIVITY FROM SURFACE POTENTIAL TIME SERIES
M. E. Spencer and R. M. Leahy 1992 7 p Presented at the 26th Annual Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, 25-30 Oct. 1992
(Contract W-7405-eng-36)
(DE93-003795; LA-UR-92-3645; CONF-9210231-3) Avail: CASI HC A02/MF A01

We address the problem of processing electroencephalographic (EEG) data to monitor the time series of the components of a current dipole source vector at a given location in the head. This is the spatial filtering problem for vector sources in a lossy, three dimensional, zero delay medium. Dipolar and distributed sources at other than the desired location are cancelled or attenuated with an adaptive linearly constrained minimum variance (LCMV) beamformer. Actual EEG data acquired from a human subject serves as the interference in a case where the desired source is simulated and superimposed on the actual data. It is shown that the LCMV beamformer extracts the desired dipole time series while effectively canceling the subjects interference. DOE

N93-23410*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

TWO TECHNIQUES FOR MEASURING LOCOMOTION IMPACT FORCES DURING ZERO G

Michael C. Greenisen, Richard A. Smith (McDonnell-Douglas Space Systems Co., Houston, TX.), Glenn K. Klute, and James B. McCaulley (McDonnell-Douglas Space Systems Co., Houston, TX.) Apr. 1993 6 p

(NASA-TP-3305; S-699; NAS 1.60:3305) Avail: CASI HC A02/MF A01

A load-cell-instrumented treadmill mated to a Kistler force plate was used to investigate two methods of force measurement instrumentation during treadmill ambulation in zero g, created by parabolic flight on NASA's KC-135 aircraft. Current spaceflight treadmills do not have adequate instrumentation to determine the resultant foot impact force applied during restrained ambulation. Accurate measurement of foot-ground reaction forces is critical in attaining proper one-g loading, therefore ensuring proper musculoskeletal conditioning. Treadmill instrumentation and force plate measurements were compared for frequency response and linearity. Locomotion impact data were also collected under one-g laboratory settings and in Keplerian flight. The first resonant frequency for both techniques was found to be well above the primary frequency content of the locomotive forces. Peak impact forces measured by the two systems compared to within 10 percent. Author

N93-23414# Construcciones Aeronauticas S.A., Madrid (Spain).

TOBACCO AND HEALTH OF THE PILOT [TABACO Y SALUD EN EL PILOTO]

Francisco FernandezMunoz 1991 5 p Repr. from Revista de Aeronautica y Astronautica, May 1991 p 590-594 In SPANISH

(ETN-93-93693) Avail: CASI HC A01/MF A01

A report on tobacco and how its effects relate to pilots is presented. Special characteristics of tobacco habits are discussed: voluntariness, addiction, noxiousness, and reversibility. Statistics on the increase in tobacco consumption in relation to nicotine level reduction, and mortalities related to smoking, are given. ESA

N93-23459# Kent State Univ., OH.

STUDY OF SCN NEUROCHEMISTRY USING IN VIVO MICRODIALYSIS IN THE CONSCIOUS BRAIN: CORRELATION WITH CIRCADIAN ACTIVITY RHYTHMS Final Report, 1 Nov. 1989 - 31 Oct. 1992

J. D. Glass, U. E. Hauser, W. Randolph, S. Ferriera, and M. A. Rea 29 Dec. 1992 14 p

(Grant AF-AFOSR-0047-90)

(AD-A259803; AFOSR-93-0031TR) Avail: CASI HC A03/MF A01

The central aim of this research is to provide information on the neurochemical processes that underlie the generation and entrainment of mammalian circadian rhythms. The studies are centered around the newly-developed in vivo brain microdialysis technique for assessing the daily patterns of neurotransmitter release in the suprachiasmatic nuclei (SCN) of freely-behaving hamsters. During the funded period, this approach yielded several new findings related to the activities of serotonergic and excitatory amino acid systems in the SCN. Specifically, it was found that: there are daily variations in extracellular concentrations of 5-HIAA and glutamate in the SCN, with highest levels occurring at night; the daily release pattern of glutamate, but not serotonin, in the SCN is circadian in nature; the rhythm in glutamate measured in SCN microdialysate is based upon a non-synaptic, calcium-dependent mechanism and does not appear to be directly linked to the expression of locomotory behavior; and serotonergic transmission suppresses glutamate in SCN microdialysate, an effect possibly related to a modulatory effect of serotonin on glutamate release in the SCN. This also may be closely related to our finding that serotonin blocks light-induced Fos protein expression in the SCN. GRA

N93-23734*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

COMPARISON OF TOTAL BODY WATER ESTIMATES FROM O-18 AND BIOELECTRICAL RESPONSE PREDICTION EQUATIONS

Linda H. Barrows (Krug Life Sciences, Inc., Houston, TX.), L. Daniel Inners (Krug Life Sciences, Inc., Houston, TX.), Marcella D. Stricklin (Krug Life Sciences, Inc., Houston, TX.), Peter D. Klein (Baylor Univ., Dallas, TX.), William W. Wong (Baylor Univ., Dallas, TX.), and Steven F. Siconolfi Apr. 1993 11 p

(NASA-TP-3299; S-696; NAS 1.60:3299) Avail: CASI HC A03/MF A01

Identification of an indirect, rapid means to measure total body water (TBW) during space flight may aid in quantifying hydration status and assist in countermeasure development. Bioelectrical response testing and hydrostatic weighing were performed on 27 subjects who ingested O-18, a naturally occurring isotope of oxygen, to measure true TBW. TBW estimates from three bioelectrical response prediction equations and fat-free mass (FFM) were compared to TBW measured from O-18. A repeated measures MANOVA with post-hoc Dunnett's Test indicated a significant (p less than 0.05) difference between TBW estimates from two of the three bioelectrical response prediction equations and O-18. TBW estimates from FFM and the Kushner & Schoeller (1986) equation yielded results that were similar to those given by O-18. Strong correlations existed between each prediction method and O-18; however, standard errors, identified through regression analyses, were higher for the bioelectrical response prediction equations compared to those derived from FFM. These findings suggest (1) the Kushner & Schoeller (1986) equation may provide a valid measure of TBW, (2) other TBW prediction equations need to be identified that have variability similar to that of FFM, and (3) bioelectrical estimates of TBW may prove valuable in quantifying hydration status during space flight. Author

N93-23984# Defence Research Establishment, Ottawa (Ontario).

AFTERRISE: DEEP BODY TEMPERATURE FOLLOWING EXERCISE Technical Note

S. Tuck and A. A. Keefe Apr. 1992 18 p

(AD-A259887; DREO-92-8) Avail: CASI HC A03/MF A01

The continued increase in rectal temperature seen after exercising in the heat is studied. Also, during recovery, the effects of posture and clothing during recovery, and temperature of the recovery room were examined. Five men exercised at a moderate intensity of 35 C and 50 percent relative humidity (RH) until their rectal temperatures reached 38.5 C. All subjects then recovered at a room temperature of 35 C or 22 C, while in a sitting or lying posture. These conditions were evaluated while the subject recovered wearing a Canadian Forces Chemical Warfare (CW) overgarment or light clothing (combat pants or shorts and a short sleeved shirt). This resulted in a total of 8 trials per subject. Rectal and skin temperatures were measured each minute during exercise and recovery. After exercise, rectal temperature increased above 38.5 C, however, this increase was slight. Posture and clothing as well as recovery environment affected the magnitude of this afterrise. It was concluded that the optimal condition in this experiment which minimized the post exercise temperature afterrise, was recovery at 22 C while sitting without the CW overgarment. GRA

N93-24009# Texas A&M Univ., College Station.

A LINEAR, TIME-VARYING SIMULATION OF THE RESPIRATORY TRACT SYSTEM Ph.D. Thesis

O. Hernandez Nov. 1992 112 p

(Contract DE-FG05-88ER-60707)

(DE93-004515; DOE/ER-60707/T3) Avail: CASI HC A06/MF A02

These results show that regional deposition efficiencies of inhaled particles are highly dependent on the level of physical activity in all the spectrum of thermodynamic and aerodynamic aerosol particle sizes; also it was shown that for particles in the aerodynamic size range, the values of regional deposition efficiencies at the inner regions of the lung are highly dependent on age. In addition, the shape of regional deposition efficiency curves as a function of particle size have a similar behavior for all ages; thus, any variation of the airway geometry and respiratory physiological parameters such as tidal volumes and breathing frequencies due to age

difference do not cause a change in the fundamental mechanisms of deposition. Thus, for all the cases of physical activity and age dependency, the deposition of ultrafine aerosol particles is highly enhanced by diffusive processes in all regions of the respiratory tract, and for very large aerosol size particles this behavior is repeated again due to impaction and sedimentation mechanisms. Although the results presented at this work, are the result of computer simulations based on different sources of experimental data, the structure of the computer simulation code BIODEP is flexible enough to the acquisition of any kind of new experimental information in terms of biokinetic analysis and regional deposition parameters. In addition, since the design of BIODEP was intended for easy access to the users, then with exception of the subroutine DIVPAG, at this moment, the modular design of BIODEP using FORTRAN 77 allows the implementation of all the subroutines of BIODEP to be used in an interactive mode with any microcomputer. DOE

N93-24021# Army Research Inst. of Environmental Medicine, Natick, MA.

SUSTAINING HEALTH AND PERFORMANCE IN THE COLD: A POCKET GUIDE TO ENVIRONMENTAL MEDICINE ASPECTS OF COLD-WEATHER OPERATIONS

A. J. Young, D. E. Roberts, D. P. Scott, J. E. Cook, and M. Z. Mays Dec. 1992 72 p

(AD-A259625; ARIEM-TN-93-2) Avail: CASI HC A04/MF A01

This technical note is a reformatted and slightly revised version of USARIEM Technical Note 92-2 - Sustaining Health and Performance In the Cold: Environmental Medicine Guidance for Cold-Weather Operations, July 1992. This pocket-sited version of the Technical Note reviews how the environment can impact an soldier health and performance during cold-weather. GRA

N93-24088# Federal Aviation Administration, Oklahoma City, OK. Civil Aeromedical Inst.

SURVEY OF AVIATION MEDICAL EXAMINERS: INFORMATION AND ATTITUDES ABOUT THE PRE-EMPLOYMENT AND PRE-APPOINTMENT DRUG TESTING PROGRAM Final Report

Jennifer G. Myers Mar. 1992 42 p

(FAA Proj. AM-C-90/91-HRR-122)

(DOT/FAA/AM-92/15) Avail: CASI HC A03/MF A01

Aviation medical examiners who are designated to collect urine specimens were surveyed to collect information and assess attitudes about different aspects of the pre-employment and pre-appointment drug testing program. Fifty-seven percent of the sample responded to the survey. Respondents were generally positive about the custody and control form, the amount of information received about the collection kits and the drug testing program, and the contacts they had with the agency medical staff. However, only about half reported they had been informed of drug testing program changes. Accurate completion of custody and control forms and lack of training were cited most often as casual factors in the occurrence of errors in the specimen collection process and few had actually received information on their error rate in specimen collections. Recommendations were made to: (1) review the custody and control form for possible improvement that may reduce errors; (2) restrict the number of AME's designated to collect specimens; (3) provide training classes, materials, or videotapes, especially for newly designated AME's, and (4) clarify the alcohol and drug abatement program manager's position prior to a decision about the organizational location of the manager. Author

N93-24092# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany). Abt. Luft- und Raumfahrtpsychologie.

STRESS RESISTANCE AS A DIAGNOSTIC CATEGORY IN AIR TRAFFIC CONTROLLER SELECTION Ph.D. Thesis - Hamburg Univ. [PSYCHISCHE BELASTBARKEIT ALS DIAGNOSTISCHE KATEGORIE IN DER EIGNUNGSAUSWAHL VON FLUGLOTSENANWAERTERN]

Manfred Barbarino Mar. 1992 173 p In GERMAN

(DLR-FB-92-13; ETN-93-93572) Avail: CASI HC A08/MF A02; DLR, Wissens chafliches Berwichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The assessment of stress resistance in the selection of applicants for air traffic control, is addressed. Stress resistance was evaluated as a multivariate diagnosis of reactivity of stress reactions (behavioral observations, self ratings of mood, peripheral physiological parameters, and cortisol in saliva). The reaction data was collected during a computer based air traffic control test. Most of the subjects showed stress reactions elicited by the test. In order to improve the assessment of stress resistance the formation of a performance strain index was recommended, which can identify different performance strain types when self ratings of mood, behavioral, and performance data are included. ESA

N93-24093# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Abt. Unterwassermedizin.

EVOKED BRAIN POTENTIALS AS INDICATORS OF A CENTRAL NERVOUS IMPAIRMENT IN A SIMULATED SATURATION DIVE TO 560 m Ph.D. Thesis - Duesseldorf Univ. [EVOZIERTE HIRNPOTENTIALE ALS INDIKATOREN FUER DIE ZENTRALNERVOESE BEEINTRAECHTIGUNG IN EINEM SIMULIERTEN SAETTIGUNGSTAUCHEXPERIMENT BIS 560 M TIEFE]

Juergen Lorenz Jun. 1992 76 p In GERMAN

(DLR-FB-92-14; ETN-93-9357363) Avail: CASI HC A05/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Posfach 90 60 58, 5000 Cologne, Germany, HC 18.50 deutsche marks

Deep saturation dives which can lead to a complex central nervous system disorder, known as HPNS (High Pressure Neurological Syndrome), are addressed. In a dry chamber dive using helium-oxygen as the breathing gas, early and late auditory evoked potentials were repeatedly recorded in two divers. Prolonging the latencies of waves 3 and 5 within the Brainstem Auditory Evoked Potentials (BAEP) correlated highly with vestibular and motor signs of HPNS at 525 m during compression. It is assumed that the ponto-mesencephale brainstem is the primary locus of the disorder because wave 1, which indicates the response of the auditory nerve, was nearly unchanged. Clinical HPNS signs largely disappeared during isopression at 545 m, as did BAEP changes. Therefore, not absolute pressure by excessive compression rate at critical depth range was probably the most important factor. Increasing prolongation of reaction time was observed in the Sternberg Memory Search Task (MST) until 545 m. The effect was dependent on number of letters to be memorized, yielding an increase in the 'slope' parameter of Sternberg's model. This points to an increase in memory scanning rate. Latency of P300 wave of the late potentials was prolonged in a similar way, if the eliciting stimuli were embedded in a secondary task performed in combination with MST. It is concluded that the environmental conditions of extreme diving depths, impair primarily the function of 'working memory' among the components of higher brain functions. Its variable expenditure is measurable by P300 values. ESA

N93-24238# Brown Univ., Providence, RI. Inst. for Brain and Neural Systems.

THEORY OF SYNAPTIC PLASTICITY IN VISUAL CORTEX

Nathan Intrator, Mark F. Bear, Leon N. Cooper, and Michael A. Paradiso 20 Jan. 1993 23 p

(Contract DAAL03-91-G-0325)

(AD-A260322; TR-16; ARO-29170.2-LS) Avail: CASI HC A03/MF A01

A short account is given of the theory of synaptic plasticity: assumptions, consequences, comparison with experiment, and statistical properties. In addition a framework for comparison with other theoretical ideas is presented. GRA

N93-24247# Texas Univ., Houston. Dept. of Neurobiology and Anatomy.

ANALYSIS AND SYNTHESIS OF ADAPTIVE NEURAL ELEMENTS AND ASSEMBLIES Annual Report, 1 Oct. 1991 - 30 Sep. 1992

John H. Byrne 14 Dec. 1992 8 p

(Grant AF-AFOSR-0027-91)

(AD-A259954; AFOSR-93-0028TR) Avail: CASI HC A02/MF A01

Between October 1, 1991 and September 30, 1992, progress was made in four areas. First, the capabilities of SNNAP, a general purpose Simulator for Neural Networks and Action Potentials, were enhanced by incorporating mathematical descriptions of intracellular levels of Ca2(+) and second messenger systems, which in turn modulate membrane conductances. Second, cellular mechanisms underlying operant conditioning were investigated in simulations of neural networks with biologically realistic properties. In one neural network, a learning rule (activity-dependent neuromodulation), which has been proposed as a cellular mechanism for classical conditioning, was demonstrated to support many features of operant conditioning. A second neural network was developed that simulates the biophysical properties of the neurons and synaptic interactions in a central

pattern generator (CPG) underlying aspects of feeding behavior - a behavior that can be modified by operant conditioning. Third, experiments characterized the modulatory actions of transmitters on the synaptic connections and the intrinsic biophysical properties of neurons in the feeding CPG. Fourth, extensions were made to the single-cell model of associative learning by incorporating quantitative descriptions of the modulation of membrane currents by 5-HT. GRA

N93-24420# California Univ., Berkeley. Dept. of Molecular Biology.
COMPUTER BASED ANALYSIS AND SYNTHESIS OF RETINAL FUNCTION Annual Report, 1 Feb. 1991 - 31 Jan. 1992
Frank S. Werblin 22 Dec. 1992 5 p
(Grant AF-AFOSR-0196-91)
(AD-A260514; AFOSR-93-0027TR) Avail: CASI HC A01/MF A01

The vertebrate retina sequentially transforms patterns of neural activity through 5 separate, serially arranged sheets of cells. These neuronal patterns become increasingly complex at each successive layer. Our objective is to determine the parameters in space and time for the transfer functions that transform the patterns at successive layers. We have extracted the space and time constants for retinal processing from the physiological data taken from single cells at each retinal layer. These space-time parameters drive an image processing computer, the PIPE. The resulting program represents a tentative blueprint for design of a retina, and some of these values have been used by modelers to make artificial retinas, including the recently developed silicon retina. GRA

N93-24590# Energetics, Inc., Columbia, MD.
POTENTIAL HUMAN HEALTH EFFECTS ASSOCIATED WITH POWER FREQUENCY ELECTRIC AND MAGNETIC FIELDS Status Report, Jun. 1991 - Jun. 1992
Aug. 1992 201 p Sponsored by Maryland Power Plant Research Program, Annapolis
(Contract PR-91-007-008)
(PB93-132678; PPRP/PPSE-T-37) Avail: CASI HC A10/MF A03

Over the past 20 years, a number of scientific studies have suggested that exposure to 60-hertz (Hz) electric and magnetic field (EMF) may be associated with human health effects, including an increased risk of cancer. Common sources of 60-Hz electric and magnetic fields include power lines, electrical wiring, ground return currents, and appliances. Some epidemiology studies have found a link between EMF exposure and certain types of cancer; however, the results of these studies are not conclusive. The scientific research that has been conducted to date (including epidemiology studies and research conducted on whole animals and cells, as well as human volunteers) has been unable to positively prove or disprove the existence of significant health effects from EMF. This report presents the major results, activities, and findings of current and ongoing EMF-related health effects research covering the time period June 1991 to May 1992. The report reviews research results from epidemiology studies, human studies, whole animal investigations, cell-level laboratory studies, exposure assessments, and engineering studies. Author

N93-22163*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
AUTOMATED SYSTEM FOR ANALYZING THE ACTIVITY OF INDIVIDUAL NEURONS
Isaac N. Bankman, Kenneth O. Johnson, Alex M. Menkes, Steve D. Diamond, and David M. OShaughnessy *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 138-145 (For primary document see N93-22149 08-99)
(Contract N00039-91-C-0001; NS-072226)
Avail: CASI HC A02/MF A04

N93-22164*# Brookhaven National Lab., Upton, NY. Medical Dept.
IMPROVED INHALATION TECHNOLOGY FOR SETTING SAFE EXPOSURE LEVELS FOR WORKPLACE CHEMICALS
Bruce O. Stuart *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 146-149 (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

N93-22188*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPTIMAL DESIGN OF COMPOSITE HIP IMPLANTS USING NASA TECHNOLOGY
T. A. Blake (Case Western Reserve Univ., Cleveland, OH.), D. A. Saravanos, D. T. Davy (Case Western Reserve Univ., Cleveland, OH.), S. A. Waters (Case Western Reserve Univ., Cleveland, OH.), and D. A. Hopkins *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 377-386 (For primary document see N93-22149 08-99)
(Grant NAG3-1027)
Avail: CASI HC A02/MF A04

N93-22189*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
FINITE ELEMENT ANALYSIS OF A COMPOSITE ARTIFICIAL ANKLE
Leigh Ann Perkins, Lawrence Johnston, Charles Denniston, and Blaise E. Czekalski (Intergraph Corp., Madison, AL.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 387-389 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22630*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
CREW HEALTH
Roger D. Billica *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 293-299 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

N93-24354# Institute of Biomedical Problems, Moscow (USSR).
PHYSIOLOGICAL EXPERIMENTS WITHIN THE PROJECT AUSTROMIR
I. C. Pestov *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 97-100 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24363# Wien Univ. (Austria). Dept. of Sports and Exercise Physiology.
DEVELOPMENT AND IMPLEMENTATION OF THE MOTOMIR EXPERIMENT ON THE MIR SPACE STATION
N. Bachl, R. Baron, I. Kozlovskáya (Institute of Biomedical Problems, Moscow, USSR.), K. H. Tschan, M. Mossaheb (FDP, Inc., Vienna, Austria.), W. Bumba (Bumba, W. Space Producing, Inc., Vienna, Austria.), I. Kharitonov (Institute of Biomedical Problems, Moscow, USSR.), R. Albrecht (European Southern Observatory, Garching, Germany.), and F. Hildebrand (Landessportbund Sachsen, Leipzig, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 147-151 (For primary document see N93-24336 08-12)
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N93-24367# Technische Univ., Graz (Austria). Physiologisches Inst.
MONITORING OF CARDIOVASCULAR PARAMETERS DURING THE AUSTROMIR SPACE FLIGHT
M. Moser, E. Gallasch, D. Rafolt, G. Jernej, C. Kemp, E. Maier, T. Kenner, R. Bayevskij (Institute of Biomedical Problems, Moscow, USSR.), I. Funtowa (Institute of Biomedical Problems, Moscow, USSR.), and Y. Avakyan (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 169-174 (For primary document see N93-24336 08-12)
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N93-24370# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna.
INFLUENCE OF MICROGRAVITY ON IMMUNE SYSTEM AND GENETIC INFORMATION
H. Tuschl, R. Kovac, W. Klein, E. Ott, Y. I. Voronkov (Institute of Biomedical Problems, Moscow, USSR.), and M. Kaidakow (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 187-191 (For primary document see N93-24336 08-12)
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N93-24386# Deutsche Sporthochschule, Cologne (Germany). Physiologisches Inst.
COLUMBUS PAYLOAD REQUIREMENTS IN HUMAN PHYSIOLOGY
Juergen Stegemann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 281-283 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24398# Nagoya Univ. (Japan). Research Inst. of Environmental Medicine.
TELESCIENCE TESTBEDDING FOR PHYSIOLOGICAL EXPERIMENTS UNDER HYPOBARIC HYPOXIC CONDITIONS
Satoru Watanabe, Masamichi Yamashita (Tokyo Univ., Sagamihara, Japan.), Takatoshi Shoji (Kawasaki Heavy Industries Ltd., Gifu, Japan.), Hiroyuki Suzuki, Sokichi Sakuragi (Aichi Univ. of Education, Japan.), Shigeo Mori, Yoshirou Wada, and Mitsuhiro Koeda (Chukyo Univ., Toyota, Japan.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 341-346 (For primary document see N93-24336 08-12)
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N93-24399# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Aerospace Medicine Inst.
CARDIOVASCULAR STRESS TEST WITH NON-INVASIVE TECHNIQUES
F. Baisch, L. Beck, I. Retat (Erno Raumfahrttechnik G.m.b.H., Bremen, Germany.), and M. Soelter (Erno Raumfahrttechnik G.m.b.H., Bremen, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 347-352 (For primary document see N93-24336 08-12)
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N93-24400# Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands). Product Centre.
A BODY MASS MEASUREMENT DEVICE BASED ON THE OSCILLATION PRINCIPLE
J. F. F. Klinkhamer and F. Brechignac (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 353-357 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24551*# University of South Florida, Tampa. Center for Engineering and Medical Image Analysis.
DIGITAL MAMMOGRAPHY, CANCER SCREENING: FACTORS IMPORTANT FOR IMAGE COMPRESSION
Laurence P. Clarke, G. James Blaine (Washington Univ., Saint Louis, MO.), Kunio Doi (Chicago Univ., IL.), Martin J. Yaffe (Toronto Univ., Ontario.), Faina Shtern (National Cancer Inst., Bethesda, MD.), G. Stephen Brown (Research Triangle Inst., Research Triangle Park, NC.), Daniel L. Winfield (Research Triangle Inst., Research Triangle Park, NC.), and Maria Kallergi (University of South Florida, Tampa.) *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 63-74 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N93-23479# York Univ. (Ontario).
SENSORY SENSITIVITIES AND DISCRIMINATIONS AND THEIR ROLES IN AVIATION Annual Report, 1 Nov. 1991 - 31 Oct. 1992
D. Regan 30 Nov. 1992 136 p
(Grant AF-AFOSR-0080-91)
(AD-A259742; AFOSR-92-0997TR) Avail: CASI HC A07/MF A02

Evidence that intersubject differences in the ability to process motion-defined (MD) shape are not predicted by the ability to process luminance-defined (LD) shape, that motion is processed by hierarchical manner, that discrimination and detection can be dissociated for MD form, and that spatial discrimination for MD and LD form are not entirely mediated by the same mechanism is as follows. Reducing presentation duration or dot lifetime from 1.0 to 0.1 sec progressively reduced the visibility of a MD bar, but did not reduce orientation discrimination for the bar when visibility was held constant. Detection and/or recognition of MD letters can be degraded by removal of brain tissues underlying prestriate cortex without affecting contrast sensitivity, Snellen acuity, low contrast acuity or sensitivity to motion. Shape discrimination for an MD rectangle can be as low as 2-3 percent--as good as for an LD rectangle. Evidence for a neural mechanism sensitive to shape independently of size, evidence for a neural mechanism directly sensitive to time to collision with an approaching object, a method for measuring intersubject differences in discrimination of time to contact, a titration method for uncovering the color-defined form system, and the 40 Hz human brain response indexes magnocellular activity is discussed. By recording the magnetic field of the brain we have identified an audio-visual integration area in the brain, we have also unconfounded responses to texture-defined form. GRA

N93-23960# Brown Univ., Providence, RI. Inst. for Brain and Neural Systems.
THEORY OF SYNAPTIC PLASTICITY IN VISUAL CORTEX
Nathan Intrator, Mark F. Bear, Leon N. Cooper, and Michael A. Paradiso 23 Dec. 1992 23 p
(Contract N00014-91-J-1316)
(AD-A260052; TR-62) Avail: CASI HC A03/MF A01

A short account is given of the theory of synaptic plasticity: assumptions, consequences, comparison with experiment, and statistical properties. In addition a framework for comparison with other theoretical ideas is presented. GRA

N93-23986# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
WHY DO WE SEE THREE-DIMENSIONAL OBJECTS?
Thomas Marill Jun. 1992 32 p
(Contract N00014-85-K-0124)
(AD-A259892; AI-M-1366) Avail: CASI HC A03/MF A01

When we look at certain line-drawings, we see three-dimensional objects. The question is why. Why not just see two-dimensional images? Our theory is that we see the objects rather than the images because the objects are simpler than the images. We define the complexity of an object as the number of bits in a pose-independent, binary representation of that object. We examine a number of examples and find that in each case the seen object is indeed simpler than the given image. This leads us to our second question. Given that we are going to see a three-dimensional object when we look at a line-drawing, which three-dimensional object will we see? Our theory is that the vision system will pick the simplest object from among the infinite set of possibilities. We examine a number of examples and find that in each case the data is consistent with the theory. This work is based on the pioneering ideas of Solomonoff and Kolmogorov, and on the more recent minimum description length concepts of Rissanen. GRA

N93-24104# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany). Abt. Luft- und Raumfahrtpsychologie.
INTERNATIONAL APPLICATION OF THE DLR TEST-SYSTEM: CONTINUATION OF THE COOPERATION WITH IBERIA IN PILOT SELECTION [INTERNATIONALE ANWENDUNG DES TEST-SYSTEMS DER DLR: FORTSETZUNG DER ZUSAMMENARBEIT MIT IBERIA BEI DER AUSWAHL VON NACHWUCHSFLUGZEUGFUEHRERN]
Gabriele Osnabruegge May 1992 59 p
(DLR-FB-92-12; ETN-93-93526) Avail: CASI HC A04/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Work to further develop a test system for the selection of student pilots is presented. Its completion by two further tests, the analysis of the personality questionnaire with regard to the intercultural comparability of its psychometric qualities, as well as the translation of the test system into Spanish language, and the results of several selection campaigns, are reported. The introduction of the two further tests, for auditory memory and for visual (short term) perception, is described. Improvements to tasks and evaluation of the simulator test which emerged during testing are reported. One group of applicants completely underwent the whole test system (those who would normally have been de-selected after paper and pencil tests were taken into the apparatus test phase) and this data analysis is given. ESA

N93-24192*# ECC International Corp., Orlando, FL. Simulations and Technology Div.
TRAINING HIGH PERFORMANCE SKILLS USING ABOVE REAL-TIME TRAINING Final Report
Dutch Guckenberger, Kevin C. Uliano (University of Central Florida, Orlando.), and Norman E. Lane (University of Central Florida, Orlando.) Jan. 1993 58 p
(Grant NAG2-750)
(NASA-CR-192616; NAS 1.26:192616) Avail: CASI HC A04/MF A01

The Above Real-Time Training (ARTT) concept is a unique approach to training high performance skills. ARTT refers to a training paradigm that places the operator in a simulated environment that functions at faster than normal time. Such a training paradigm represents a departure from the intuitive, but not often supported, feeling that the best practice is determined by the training environment with the highest fidelity. This approach is hypothesized to provide greater 'transfer value' per simulation trial, by incorporating training techniques and instructional features into the simulator. These techniques allow individuals to acquire these critical skills faster and with greater retention. ARTT also allows an individual trained in 'fast time' to operate at what appears to be a more confident state, when the same task is performed in a real-time environment. Two related experiments are discussed. The findings appear to be consistent with previous findings that show positive effects of task variation during training. Moreover, ARTT has merit in improving or maintaining transfer with sharp reductions in training time. There are indications that the effectiveness of ARTT varies as a function of task content and possibly task difficulty. Other implications for ARTT are discussed along with future research directions. Author (revised)

N93-24227# SRI International Corp., Menlo Park, CA. Artificial Intelligence Center.
INTERPRETATION AS ABDUCTION
Jerry R. Hobbs, Mark Stickel, Douglas Appelt, and Paul Martin 1992 68 p
(Contracts N00014-85-C-0013; N00014-90-C-0220)
(AD-A259608) Avail: CASI HC A04/MF A01

Abduction is inference to the best explanation. In the TACITUS project at SRI we have developed an approach to abductive inference, called weighted abduction, that has resulted in a significant simplification of how the problem of interpreting texts is conceptualized. The interpretation of a text is the minimal explanation of why the text would be true. More precisely, to interpret a text, one must prove the logical form of the text from what is already mutually known, allowing for coercions, merging redundancies where possible, and making assumptions where necessary. It is shown how such local pragmatics problems as reference resolution, the interpretation of compound nominals, the resolution of syntactic ambiguity and metonymy, and schema recognition can be solved in this manner. Moreover, this approach of interpretation as abduction can be combined with the older view of parsing as deduction to produce an elegant and thorough integration of syntax, semantics, and pragmatics, one that spans the range of linguistic phenomena from phonology to discourse structure. Finally, we discuss means for making the abduction process efficient, possibilities for extending the approach to other pragmatics phenomena, and the semantics of the weights and costs in the abduction scheme. GRA

N93-24297# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Physiology.
EYE MOVEMENTS AND VISUAL INFORMATION PROCESSING Annual Report, 30 Sep. 1991 - 29 Sep. 1992
Eileen Kowler 1992 4 p
(Grant AF-AFOSR-0342-91)
(AD-A259955; AFOSR-93-0024TR) Avail: CASI HC A01/MF A01

The central goal of the project funded by the current grant is the understanding of how saccadic eye movements are used to accurately localize objects in space. Explaining accurate localization is a real problem because the objects we choose to look at are relatively large -- typically extending over several degrees of space -- but the saccadic eye movement must land at one place within the target. Our published research suggests that the computation requires a sequence of two stages: (1) voluntary attentional weighting of information in the visual display, and (2) automatic-spatial-pooling of the weighted formation (He and Kowler, 1989; 1991). GRA

N93-24319# Naval Aerospace Medical Research Lab., Pensacola, FL.
THE FIVE-FACTOR PERSONALITY MODEL AND NAVAL AVIATION CANDIDATES
Kathleen T. Helton and David R. Street, Jr. Nov. 1992 16 p
(DA Proj. M00-96; DA Proj. M00-96)
(AD-A260227; NAMRL-1379) Avail: CASI HC A03/MF A01

As personality testing has improved, various models for constructing and interpreting aviation selection tests have been proposed. Of particular interest to our study is the use of the five-factor personality model to naval aviation selection test interpretation and development. The five personality factors are conscientiousness, agreeableness, openness, extraversion, and neuroticism. Therefore, we conducted a joint factor analysis on the Pilot Personality Questionnaire (PPQ) and the Edwards Personal Preference Schedule (EPPS) taken by 158 Navy and Marine Corps student aviators. A principal component analysis (PCA) and a factor analysis (FA) with varimax rotations produced a robust five-factor solution. On the basis of content analysis, the FA factors obtained in our study coincided with the five classic dimensions of the five-factor personality model. Although investigations of personality in pilot selection have yielded mixed results, the finding of a five-factor solution in our study suggests that the five-factor personality model may be useful in personality testing in aviation selection decisions. GRA

N93-24431# Army Aeromedical Research Lab., Fort Rucker, AL.
HUMAN VISUAL LIMITATIONS ON SUPRATHRESHOLD CONTRAST PERCEPTION THROUGH ANVIS Final Report
Jeff C. Rabin Dec. 1992 24 p
(DA Proj. 3M1-62787-A-879)
(AD-A259970; USAARL-93-3) Avail: CASI HC A03/MF A01

Recent success on the battlefield underscored the tactical advantage of night operations and image intensifying devices. It is important to understand both the benefits and limitations inherent in these devices. While several studies have focused on spatial resolution thresholds through image intensifiers, less is known about visual perception at suprathreshold levels of stimulation. Such information is necessary to anticipate and predict visual performance under various conditions. In this study contrast matching was used to evaluate suprathreshold visual perception under conditions which simulated the luminance, contrast, and chromaticity of third generation image intensifiers contained in the Aviator's Night Vision Imaging System (ANVIS). The apparent contrast of letters in this simulated ANVIS environment was reduced by a factor of two when compared to normal photopic levels of stimulation. This effect was attributed to limitations of the human visual system in processing higher spatial frequencies at low light levels. Theme results help to quantify and discriminate between visual and electro-optical limitations on vision through image intensifiers. GRA

N93-24345# European Space Agency, Cologne (Germany). Astronauts Div.
SELECTION OF ASTRONAUTS FOR EUROPEAN SPACE MISSIONS
F. Rossitto and H. Schaarschmidt *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 51-53 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24346# European Space Agency, Cologne (Germany). European Astronauts Div.
THE EUROPEAN ASTRONAUTS TRAINING PROGRAMME
K. Damian, O. Chiarenza, H. Arend, and P. Nespoli *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 55-61 (For primary document see N93-24336 08-12)
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N93-24352# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Crew Operations Dept.
MIR 1992 OPERATIONS AND CREW TRAINING
Bolender, R. Ewald, K.-D. Flade, S. Jaehn, R. Lentzen, A. Putzka, A. Schoen, H. Steimle, H. Stromeyer, and W. Wyborny *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 87-89 (For primary document see N93-24336 08-12)
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N93-24366# Technische Univ., Vienna (Austria). Universitaetsklinik fuer Neurologie.
OPTOVERT: AN AUSTROMIR-1991 EXPERIMENT. ORIENTATIONAL EFFECTS FROM OPTOKINETIC STIMULATION
C. Mueller, L. Kornilova (Institute of Biomedical Problems, Moscow, USSR.), G. Wiest, and L. Deecke *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 163-167 (For primary document see N93-24336 08-12)
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N93-24382# Danish Aerospace Medical Center of Research, Copenhagen.
TRAINING CONCEPT FOR CREW, END USER, AND GROUND CENTRE PERSONNEL IN THE COLUMBUS UTILISATION PROGRAMME
T. A. E. Andersen, H. T. Blume (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), H. Duwe (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), N. Eilersen, M. Gaida (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. Herten (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), T.-H. Iversen, and C. Jungius (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 257-262 (For primary document see N93-24336 08-12)
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54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N93-22389# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). UB Flugzeuge, Cockpitsysteme und Ergonomie.
USER AREAS IN AIRCRAFT COCKPIT, USING METHODS OF RAPID PROTOTYPE DEVELOPMENT [BENUTZEROBERFLAECHEN IM FLUGZEUGCOCKPIT MIT METHODEN DER SCHNELLEN PROTOTYPENENTWICKLUNG]
Alexander Rumpf and Burkhard Balser Sep. 1990 13 p In GERMAN Presented at 33rd DGLR Fachausschusssitzung, Hamburg, Germany, 25-26 Sep. 1990 Submitted for publication
(MBB-FE-315-S-PUB-0493; ETN-93-93435) Avail: CASI HC A03/MF A01

A study which shows that System Prototyping Rig (SPR) is a development implement which meets perfectly with the present requirements of a modern system implement is presented. SPR allows compliance with the most important tasks in the development phases of the new system. The application of such an implement leads to a minimization of development risks, used time, and costs. The software package Virtual Avionics Prototyping System (VAPS) is described as a tool for the generation of virtual, interactive man machine interface. A permanent further development and a continuous adaptation of new technologies are necessary to obtain the efficiency of the tool. ESA

N93-22663*# Life Systems, Inc., Cleveland, OH.
INTEGRATED OXYGEN RECOVERY SYSTEM Bimonthly Technical Progress Report No. 1, 8 Jan. - 8 Mar. 1993
M. Gene Lee and Ronald J. Davenport 8 Mar. 1993 21 p
(Contract NAS8-39843)
(NASA-CR-192343; NAS 1.26:192343; TR-1619-1-1) Avail: CASI HC A03/MF A01

Life Systems has conceptualized an innovative Integrated Oxygen Recovery System (IORS) applicable to advanced mission air revitalization. The IORS provides the capability to electrochemically generate metabolic oxygen (O2) and recover O2 from the space habitat atmosphere via a carbon dioxide (CO2) reduction process within a single assembly. To achieve this capability, the IORS utilizes a Solid Metal Cathode (SMC) water electrolysis unit that simultaneously serves as the Sabatier CO2 reduction reactor. The IORS enables two major life support systems currently baselined in closed loop air revitalization systems to be combined into one smaller, less complex system. This concept reduces fluidic and electrical interface requirements and eliminates a hydrogen (H2) interface. Life Systems is performing an evaluation of the IORS process directed at demonstrating performance and quantifying key physical characteristics including power, weight, and volume. Technical progress achieved during the first two months of the program is summarized. Author

N93-23129*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EVALUATION OF HOLE SIZES IN STRUCTURES REQUIRING EVA SERVICES AS A MEANS TO PREVENT GLOVED-HAND FINGER ENTRAPMENT
Sudhakar L. Rajulu (Lockheed Engineering and Sciences Co., Houston, TX.) and Glenn K. Klute Apr. 1993 15 p
(Contract NAS9-17900)
(NASA-TM-104767; S-717; NAS 1.15:104767; LESC-30689) Avail: CASI HC A03/MF A01

One of the concerns of Space Station designers was making sure that the suited crewmembers' gloved fingers are not trapped in the holes that may be present in the structures during EVA activities. A study was conducted on 11 subjects to determine the minimum and maximum possible hole sizes that would eliminate the possibility of finger entrapment. Subjects wore pressurized gloves and attempted to insert their fingers into holes of various sizes. Based on the experimental results, it is recommended that the smallest diameter should be less than 13.0 mm and the largest diameter should be greater than 35.0 mm in order to eliminate the possibility of

finger entrapment while wearing gloves. It is also recommended that the current requirements specified by the MSIS-STD-3000 (Section 6.3.3.4) should be modified accordingly. Author

N93-23451# Naval Air Warfare Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.

THE EFFECTS OF DISPLAY AND RESPONSE CODES ON INFORMATION PROCESSING IN AN IDENTIFICATION TASK Ph.D. Thesis Final Report

Jeffrey G. Morrison 23 Sep. 1992 341 p

(AD-A259531; NAWACDWAR-92088-60; NADC-92088-60) Avail: CASI HC A15/MF A03

Four experiments are reported that employ the Within-Task Subtractive (WiTS) method for partitioning response time. The assumptions and advantages of this methodology are discussed relative to subtractive and additive factors methodology. Code and coding issues such as the particular target-task combination used, response mapping, target density, and blocks were manipulated. Study 1 showed that digits were processed differently from letters in terms of input and output processing. Study 2 showed that the identification of different categories of codes in the presence of noise codes generated different effects on input and output processing. Study 3 examined the identification of codes from multiple code categories when there is a single code per target versus when there are multiple codes per target. The results show that while there are differences in input processing depending on the location of codes, when the results are considered on a per-code basis, the differences in input are accounted for by the different number of visual fixations required, rather than differences in processing. Study 4 examined the effects of identifying redundant codes. Redundant codes were processed as separate codes early in practice, and processed as a single, composite code late in practice during input, and were output much faster than relevant, non-redundant codes in output. GRA

N93-23647# Galaxy Scientific Corp., Atlanta, GA.

HUMAN FACTORS ISSUES IN AIRCRAFT MAINTENANCE AND INSPECTION. SCIENCE, TECHNOLOGY, AND MANAGEMENT: A PROGRAM REVIEW

Aug. 1992 252 p Meeting held in Atlanta, GA, 5-6 Aug. 1992

(Contract DTFA01-92-Y-01005)

(PB93-146975) Avail: CASI HC A12/MF A03

The report presents the proceedings of the seventh in a series of meetings sponsored by the Federal Aviation Administration (FAA). These meetings address issues of human factors in aviation maintenance and inspection. This two-day meeting, in August 1992, directed attention to science, technology, and management. This triad was addressed by eighteen speakers from industry, government, the Department of Defense, and academia. Many of the presentations served as a review of the Human Factors in Aviation Maintenance Research Program. The Office of Aviation Medicine Human Factors in Aviation Maintenance Research Program has responded to many of the topics in the National Plan for Aviation Human Factors. The National Plan combines issues of science and technology with a management plan to define approaches to a broad range of human factors issues in aviation. The MM's responses are presented. The responses address topics related to work environments, tools, procedures, training, documentation, and innovative maintenance management practices. The Aviation Medicine research is complimented by presentations from airline, manufacturers, and Department of Defense personnel. GRA

N93-23660# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.

COMPARATIVE EVALUATION OF A MONOCULAR HEAD MOUNTED DISPLAY DEVICE VERSUS A FLAT SCREEN DISPLAY DEVICE IN PRESENTING AIRCRAFT MAINTENANCE TECHNICAL DATA M.S. Thesis

Jeffrey A. Friend and Randy S. Grinstead Sep. 1992 166 p

(AD-A259684; AFIT/GSM/LSM/92S-8) Avail: CASI HC A08/MF A02

As military developers provide increasingly complex weapon systems, it becomes more difficult for maintenance technicians to perform their jobs. One aspect of the technicians' world is the need to access technical information in the performance of their duties. This study investigated two electronic display systems to evaluate which enhanced technician performance more. A Head Mounted Display (HMD) device and a portable hand-held flat-screen computer were evaluated in the performance of two flightline maintenance activities. Although both display systems were fully portable and self contained, only the HMD system allowed continuous access to technical information during task performance. In most cases, technicians using the IBM system outperformed those equipped with the flat-screen computer system in terms of effectiveness and efficiency. GRA

N93-23992# Army Aeromedical Research Lab., Fort Rucker, AL.

IN-FLIGHT FIELD-OF-VIEW WITH ANVIS Final Report

John C. Kotulak Dec. 1992 69 p

(DA Proj. 3M1-62787-A-879)

(AD-A259905; USAARL-93-8) Avail: CASI HC A04/MF A01

This investigation had four major goals: (1) to measure the in-flight field-of-view (FOV) of a large sample of aviators (n = 105) using the AN/AVS-6 Aviator's Night Vision Imaging System (ANVIS); (2) to assess the degree to which in-flight ANVIS FOV restrictions result from improper user adjustments as opposed to equipment limitations; (3) to determine which epidemiological factors might be associated with reduced FOV; and (3) to evaluate options for optimizing in-flight ANVIS FOV. It was concluded that only about 15 percent of aviators actually achieve a 40 deg FOV with ANVIS during flight. The FOV's were reduced mostly because of equipment limitations, and not because of user misadjustments. Specifically, the fore-aft adjustment of the ANVIS helmet mount lacks sufficient range in the aft direction. Among the epidemiological factors studied, only total flight hours, hours in current aircraft, hours in last 12 months, and aircraft type are statistically related to in-flight ANVIS FOV. Total night vision goggle flight hours, ANVIS flight hours, helmet size, type of helmet liner, and spectacle use are not related to in-flight ANVIS FOV. Finally, it was determined that most aviators could achieve a 40 deg FOV if either of two hardware modifications were made: improving the fore-aft adjustment range of the ANVIS mount, or switching to a different eyepiece with a greater eye relief. GRA

N93-23995# Army Aeromedical Research Lab., Fort Rucker, AL.

EFFECTS ON PHYSIOLOGY AND PERFORMANCE OF WEARING THE AVIATOR NBC ENSEMBLE WHILE FLYING THE UH-60 HELICOPTER FLIGHT SIMULATOR IN A CONTROLLED HEAT ENVIRONMENT Final Report, Aug. 1989 - Nov. 1991

Robert Thornton, J. L. Caldwell, Wayne Clark, Frank Guardiani, and Jose Rosario Sep. 1992 173 p

(AD-A259909; USAARL-92-36) Avail: CASI HC A08/MF A02

The physiological and performance effects of wearing U.S. Army aviator NBC individual protective equipment (IPE) were evaluated in the USAARL UH-60 research flight simulator. Sixteen male aviators flew the simulator in four test conditions: standard flight suit and cool cockpit, standard flight suit and hot cockpit, NBC IPE and cool cockpit, and NBC IPE and hot cockpit. The hot condition had a wet bulb globe temperature (WBGT) of 30.6 C, the cool 17.9 C. Rectal temperature, mean skin temperature, and heart rate were monitored and showed significant increases for the NBC hot condition compared with the other three. There was a significant degree of dehydration in the hot NBC condition. Seven subjects failed to complete the sortie in the NBC hot condition, with a mean survival time of 298 minutes. All subjects flew for the target 6 hours in the other conditions. Simulator flight performance showed significant impairment in the hot NBC condition. There was little evidence of a reduction in flight performance with time. Six crashes occurred in NBC IPE, one in the standard flight suit. A performance assessment battery also was undertaken before, and at regular intervals during flight. The battery showed no effect of condition, though it was sensitive to increasing time on each test day. A subjective questionnaire assessment showed increasing fatigue with time, and that all conditions produced significantly more fatigue than baseline with the worse being for NBC hot. GRA

N93-24001# Dynamics Research Corp., Wilmington, MA.

ATTENTION FACTORS ASSOCIATED WITH HEAD-UP DISPLAY AND HELMET-MOUNTED DISPLAY SYSTEMS Final Report, Jul. - Dec. 1991

John C. Morey and Robert Simon Jan. 1993 64 p

(Contract MDA903-87-C-0523)

(AD-A260204; E-19298U; ARI-RN-93-12) Avail: CASI HC A04/MF A01

A review of human attention research literature relevant to head-up display (HUD) and helmet-mounted display (HMD) systems in use or under development for rotary-wing aircraft is presented. The fundamental attentional

issue for HUD's and HMD's is division of attention between the outside-the-window scene and the displayed symbology. Selective attention applies more to elements within the HUD or HMD symbology. The review identified a number of areas for further research. These are effects of dichoptic viewing, eye dominance, identification of strategies for effective time-sharing, HUD and HMD training, and pilot selection. GRA

N93-24067# Wright State Univ., Dayton, OH. Dept. of Psychology.
PERCEPTION/ACTION: AN HOLISTIC APPROACH Final Report, 15 Dec. 1990 - 29 Aug. 1992
John M. Flach Oct. 1992 46 p
(Grant AF-AFOSR-1051-91)
(AD-A259597; WSU-FR-661805; AFOSR-92-1019TR) Avail: CASI HC A03/MF A01

A general systems approach is taken to studying the emergent properties of the human perception/action system. Two task domains, the control of locomotion and the recognition of objects, are used to study human performance. The locomotion task involves the control of altitude. Experiments are described that will manipulate the type of texture, the speed of forward motion, and altitude. A general hypothesis is presented that performance in the altitude control task is a function of the signal-to-noise ratio within the flow field--where signal refers to optical activity resulting from change of altitude and noise refers to optical activity resulting from other sources. An analysis of the flow geometry is presented to illustrate how the motion of the observer and the position of texture elements combine to determine the optical information available to the observer. The object recognition task involves the discrimination of 3-dimensional wire-frame forms using the information available in dynamic occlusion. A key manipulation within this task was the mode of observation. Observers were either active (they could manipulate the object using a joystick to produce dynamic occlusion) or they were passive (they could observe the motions produced by the active observer, but they could not act on the display to produce dynamic occlusions). Three experiments are presented. The most important result was that no differences were found as a function of mode. In all three experiments passive observers performed at least as well as active observers. GRA

N93-24128# Programming and Systems Management, Inc., Dayton, OH.
AN INNOVATIVE METHOD FOR HAND PROTECTION FROM EXTREME COLD USING HEAT PIPE Final Report, 1 Jul. 1986 - Feb. 1987
A. Faghri, D. B. Reynolds, and B. Bahramian Dec. 1992 75 p
(AD-A259720; NATICK-TR-93/005) Avail: CASI HC A04/MF A01

Due to the danger of frostbite at very low ambient temperatures, there is a need to develop new handwear technology to protect the fingers at temperatures down to about -80 F (-62 C). The shortcomings of the existing technology, a glove with a heating element, are needed for maintenance, size, and limited capacity of the current batteries. An innovative method was investigated to transfer some of the body core thermal energy to the hands. This method involves the use of heat pipe technology, which has the advantages of very high effective heat conductivity, fast response time, flexibility low mass, compact size, and ease of maintenance. The design uses the person's elbow area as the heat source. The heat pipe extends along the arm and terminates at the surface of the back of the hand. From a simple model of the insulated arm and hand, the required heat transfer to the hand by the heat pipe to maintain a hand temperature of -81 F (27 C) with ambient temperature of -80 F (62 C) was shown to vary from 5.8 to 21 W for an insulation 'R' value from 0.741 to 0.185 m(sup 2)C/W. A very efficient and flexible heat pipe was developed and tested to show the feasibility of the use of heat pipe technology in the above application. Heat capacities between 1 and 5 W were measured, depending upon orientation with respect to gravity. Due to the necessity of transferring 1 to 5 times this amount of heat and to provide for more uniform heat distribution, these results indicate that multiple heat pipes may be required in the design of a handwear system. GRA

N93-24168# Aeronautical Systems Div., Wright-Patterson AFB, OH.
ATTITUDE AWARENESS ENHANCEMENTS FOR THE F-16 HEAD-UP DISPLAY Final Report, 1 Mar. - 30 Jun. 1992
Scott M. Cone and John A. Hassoun Oct. 1992 47 p
(AD-A260280; ASC-TR-92-5017) Avail: CASI HC A03/MF A01

In an effort to reduce the Collision With Ground (CWG) and Spatial Disorientation (SDO) mishaps, the F-16 System Program Office (SPO) has initiated an effort to improve F-16 C/D head-up display (HUD) symbology. In support of this effort, the SPO identified a set of attitude awareness enhancements for potential incorporation into the aircraft. These were (1) extended horizon, (2) ghost horizon, (3) articulated nose down pitch bars, (4) removal of 2:1 pitch scale compression, (5) moving nose down pitch bar tic marks to the inside of the pitch bars, (6) modified bank angle indicator, and (7) modified zenith/nadir symbols. Prior to the incorporation of these enhancements, the Crew Station Evaluation Facility (CSEF) performed a simulation evaluation to assess the improvement in attitude awareness provided by these changes. Fifteen pilots flew a series of unusual attitude recoveries and mission demonstration tasks during which reaction time, error rate, and subjective ratings were collected. Results showed faster reaction times, especially in nose-down conditions, and strong subjective preference for the modified HUD format. Based on these results, the CSEF recommended the incorporation of the extended horizon, ghost horizon, modified pitch ladder, and modified zenith/nadir symbols (low priority). Ratings for the bank angle indicator were mixed. It is recommended that the bank angle indicator be evaluated in instrument flying conditions before being considered for incorporation into the F-16 HUD. GRA

N93-24441# Army Aeromedical Research Lab., Fort Rucker, AL.
AN AUTOMATED METHOD FOR DETERMINING MASS PROPERTIES Final Report
Michael B. Deavers and B. J. McEntire Dec. 1992 33 p
(AD-A259924; USAARL-93-4) Avail: CASI HC A03/MF A01

The U.S. Army Aeromedical Research Laboratory performs mass properties testing with the KSR330-60 Mass Properties Instrument (MPI). For man-mounted equipment, it is important to define and measure the mass properties in order to accurately develop math models, understand human performance impacts, and to conduct comparative evaluations. Determining mass properties requires a thorough theoretical understanding of the center-of-mass and mass moments of inertia. This report provides the operating theory and procedures to measure mass properties with the MPI. GRA

N93-24490*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A DEMONSTRATION OF MOTION BASE DESIGN ALTERNATIVES FOR THE NATIONAL ADVANCED DRIVING SIMULATOR
Michael E. McCauley (Monterey Technologies, Inc., Carmel, CA.), Thomas J. Sharkey (Monterey Technologies, Inc., Carmel, CA.), John B. Sinacori (Sinacori, John B. Associates, Hollister, CA.), Soren LaForce (SYRE Corp., Moffett Field, CA.), James C. Miller, and Anthony Cook Oct. 1992 24 p
(RTOP 505-64-29)
(NASA-TM-103881; A-91204; NAS 1.15:103881) Avail: CASI HC A03/MF A01

A demonstration of the capability of NASA's Vertical Motion Simulator to simulate two alternative motion base designs for the National Advanced Driving simulator (NADS) is reported. The VMS is located at ARC. The motion base conditions used in this demonstration were as follows: (1) a large translational motion base; and (2) a motion base design with limited translational capability. The latter had translational capability representative of a typical synergistic motion platform. These alternatives were selected to test the prediction that large amplitude translational motion would result in a lower incidence or severity of simulator induced sickness (SIS) than would a limited translational motion base. A total of 10 drivers performed two tasks, slaloms and quick-stops, using each of the motion bases. Physiological, objective, and subjective measures were collected. No reliable differences in SIS between the motion base conditions was found in this demonstration. However, in light of the cost considerations and engineering challenges associated with implementing a large translation motion base, performance of a formal study is recommended. Author (revised)

N93-24502# Sandia National Labs., Albuquerque, NM.
TREATMENT OF HUMAN-COMPUTER INTERFACE IN A DECISION SUPPORT SYSTEM
A. S. Heger, F. A. Duran (New Mexico Univ., Albuquerque.), S. Frysinger (Bell Telephone Labs., Inc., Holmdel, NJ.), and R. G. Cox 1992 5 p
Presented at the 1992 IEEE System, Man and Cybernetics Conference, Chicago, IL, 18-21 Oct. 1992

(Contract DE-AC04-76DP-00789)
(DE93-002281; SAND-92-1903C; CONF-9210177-2) Avail: CASI HC A01/MF A01

One of the most challenging applications facing the computer community is development of effective adaptive human-computer interface. This challenge stems from the complex nature of the human part of this symbiosis. The application of this discipline to the environmental restoration and waste management is further complicated due to the nature of environmental data. The information that is required to manage environmental impacts of human activity is fundamentally complex. This paper discusses the efforts at Sandia National Laboratories in developing the adaptive conceptual model manager within the constraint of the environmental decision-making. A computer workstation, that hosts the Conceptual Model Manager and the Sandia Environmental Decision Support System is also discussed. DOE

N93-22167*# Jasper (Louis J., Jr), Fulton, MD.
VARIABLE-VOLUME FLUSHING (V-VF) DEVICE FOR WATER CONSERVATION IN TOILETS
Louis J. Jasper, Jr. *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 175-179 (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

N93-22190*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DESIGN OF A PORTABLE POWERED SEAT LIFT
Bruce Weddendorf *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 390-396 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22191*# General Engineering and Systems Analysis Co., Inc., Kearneysville, WV.
MICROCOMPUTER BASED SOFTWARE FOR BIODYNAMIC SIMULATION
N. Rangarajan and T. Shams *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 397-405 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22195*# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.
OPERATOR PERFORMANCE SUPPORT SYSTEM (OPSS)
Marlen Z. Conklin (Nova Univ., Dania, FL.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 439-444 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22268*# Department of the Air Force, Kirtland AFB, NM.
TALON AND CRADLE: SYSTEMS FOR THE RESCUE OF TUMBLING SPACECRAFT AND ASTRONAUTS Abstract Only
Dunning Idle, V *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 1 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22628*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CLOSED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS) TEST FACILITY
Robert D. MacElroy *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 283-290 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

N93-22640*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ZERO-G LIFE SUPPORT FOR SPACE STATION FREEDOM
Matthew Kolodney (Lockheed Engineering and Sciences Co., Houston, TX.) and L. Dall-Bauman *In* NASA, Washington, Space Station Freedom Utilization Conference 1992 p 407-414 (For primary document see N93-22606 08-18)
Avail: CASI HC A02/MF A04

N93-24362# Innsbruck Univ. (Austria). Dept. for Neurology.
EYE-HEAD-ARM COORDINATION AND SPINAL REFLEXES IN WEIGHTLESSNESS
M. Berger, F. Gerstenbrand, N. Burlatschkova, A. Muigg, L. Grill, G. Holzmueller, I. B. Kozlovskaya (Institute of Biomedical Problems, Moscow, USSR.), M. Borisov (Institute of Biomedical Problems, Moscow, USSR.), B. Babaev (Institute of Biomedical Problems, Moscow, USSR.), and A. Sokolov (Institute of Biomedical Problems, Moscow, USSR.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 139-145 (For primary document see N93-24336 08-12)
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N93-24406# Ruhr Univ., Bochum (Germany). Comparative Endocrinology Research Station.
ECOSYSTEMS ON EARTH AND IN SPACE (THE POSSIBLE UTILIZATION OF ARTIFICIAL ECOSYSTEMS FOR SPACE LIFE SUPPORT SYSTEMS)
V. Bluem *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 393-398 (For primary document see N93-24336 08-12)
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55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N93-23908# Observatoire de Paris-Meudon (France).
SETI IN EUROPE
Jean Heidmann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 165-166 (For primary document see N93-23878 08-88)
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N93-24373# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Biophysics Div.
LIFE IN AND FROM SPACE
G. Horneck *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 207-210 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24405# Centre National de la Recherche Scientifique, Orleans (France). Centre de Biophysique Moleculaire.
EXOBIOLOGY AND TERRESTRIAL LIFE
Andre Brack *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 387-391 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N93-22810*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THE df: A PROPOSED DATA FORMAT STANDARD

Leslie R. Lait (Universities Space Research Association, Columbia, MD.), Eric R. Nash (Applied Research Corp., Landover, MD.), and Paul A. Newman Mar. 1993 181 p

(NASA-TM-4467; NAS 1.15:4467; Rept-93B00047) Avail: CASI HC A09/MF A02

A standard is proposed describing a portable format for electronic exchange of data in the physical sciences. Writing scientific data in a standard format has three basic advantages: portability; the ability to use metadata to aid in interpretation of the data (understandability); and reusability. An improperly formulated standard format tends towards four disadvantages: (1) it can be inflexible and fail to allow the user to express his data as needed; (2) reading and writing such datasets can involve high overhead in computing time and storage space; (3) the format may be accessible only on certain machines using certain languages; and (4) under some circumstances it may be uncertain whether a given dataset actually conforms to the standard. A format was designed which enhances these advantages and lessens the disadvantages. The fundamental approach is to allow the user to make her own choices regarding strategic tradeoffs to achieve the performance desired in her local environment. The choices made are encoded in a specific and portable way in a set of records. A fully detailed description and specification of the format is given, and examples are used to illustrate various concepts. Implementation is discussed. Author

N93-23240*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ADVANCING AUTOMATION AND ROBOTICS TECHNOLOGY FOR THE SPACE STATION FREEDOM AND FOR THE U.S. ECONOMY Progress Report No. 13

Nov. 1991 49 p

(RTOP 476-14-01)

(NASA-TM-103895; A-91235; NAS 1.15:103895) Avail: CASI HC A03/MF A01

In April 1985, as required by Public Law 98-371, the NASA Advanced Technology Advisory Committee (ATAC) reported to Congress the results of its studies on advanced automation and robotics technology for use on Space Station Freedom. This material was documented in the initial report (NASA Technical Memorandum 87566). A further requirement of the law was that ATAC follow NASA's progress in this area and report to Congress semiannually. This report is the thirteenth in a series of progress updates and covers the period between 14 Feb. - 15 Aug. 1991. The progress made by Levels 1, 2, and 3 of the Space Station Freedom in developing and applying advanced automation and robotics technology is described. Emphasis was placed upon the Space Station Freedom Program responses to specific recommendations made in ATAC Progress Report 12, and issues of A&R implementation into Ground Mission Operations and A&R enhancement of science productivity. Assessments are presented for these and other areas as they apply to the advancement of automation and robotics technology for Space Station Freedom. Author (revised)

N93-24544*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THE 1993 SPACE AND EARTH SCIENCE DATA COMPRESSION WORKSHOP

James C. Tilton, ed. Washington Apr. 1993 119 p Workshop held in Snowbird, UT, 2 Apr. 1993; cosponsored by IEEE

(RTOP 936-00-00)

(NASA-CP-3191; Rept-93B00034; NAS 1.55:3191) Avail: CASI HC A06/MF A02

The Earth Observing System Data and Information System (EOSDIS) is described in terms of its data volume, data rate, and data distribution requirements. Opportunities for data compression in EOSDIS are discussed. For individual titles, see N93-24545 through N93-24555.

N93-24545*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

DATA COMPRESSION OPPORTUNITIES IN EOSDIS **c82**

Ben Kobler and John Berbert *In its* The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 3-5 (For primary document see N93-24544 08-59)

Avail: CASI HC A01/MF A02

The Earth Observing System Data and Information System (EOSDIS) is described in terms of its data volume, data rate, and data distribution requirements. Opportunities for data compression in EOSDIS are discussed. Author

N93-24546*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

COMPRESSION THROUGH DECOMPOSITION INTO BROWSE AND RESIDUAL IMAGES **c82**

Dmitry A. Novik (Universal Systems, Inc., Arlington, VA.), James C. Tilton, and M. Manohar (Universities Space Research Association, Greenbelt, MD.) *In its* The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 7-12 (For primary document see N93-24544 08-59)

Avail: CASI HC A02/MF A02

Economical archival and retrieval of image data is becoming increasingly important considering the unprecedented data volumes expected from the Earth Observing System (EOS) instruments. For cost effective browsing the image data (possibly from remote site), and retrieving the original image data from the data archive, we suggest an integrated image browse and data archive system employing incremental transmission. We produce our browse image data with the JPEG/DCT lossy compression approach. Image residual data is then obtained by taking the pixel by pixel differences between the original data and the browse image data. We then code the residual data with a form of variable length coding called diagonal coding. In our experiments, the JPEG/DCT is used at different quality factors (Q) to generate the browse and residual data. The algorithm has been tested on band 4 of two Thematic mapper (TM) data sets. The best overall compression ratios (of about 1.7) were obtained when a quality factor of Q=50 was used to produce browse data at a compression ratio of 10 to 11. At this quality factor the browse image data has virtually no visible distortions for the images tested. Author (revised)

N93-24547*# Los Alamos National Lab., NM. Computer Research Group.

APPLICATIONS OF WAVELET-BASED COMPRESSION TO MULTIDIMENSIONAL EARTH SCIENCE DATA **c82**

Jonathan N. Bradley and Christopher M. Brislawn *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 13-24 (For primary document see N93-24544 08-59)

Avail: CASI HC A03/MF A02

A data compression algorithm involving vector quantization (VQ) and the discrete wavelet transform (DWT) is applied to two different types of multidimensional digital earth-science data. The algorithms (WVQ) is optimized for each particular application through an optimization procedure that assigns VQ parameters to the wavelet transform subbands subject to constraints on compression ratio and encoding complexity. Preliminary results of compressing global ocean model data generated on a Thinking Machines CM-200 supercomputer are presented. The WVQ scheme is used in both a predictive and nonpredictive mode. Parameters generated by the optimization algorithm are reported, as are signal-to-noise (SNR) measurements of actual quantized data. The problem of extrapolating hydrodynamic variables across the continental landmasses in order to compute the DWT on a rectangular grid is discussed. Results are also presented for compressing Landsat TM 7-band data using the WVQ scheme. The formulation of the optimization problem is presented along with SNR measurements of actual quantized data. Postprocessing applications are considered in which the seven spectral bands are clustered into 256 clusters using a k-means algorithm and analyzed using the Los Alamos multispectral data analysis program, SPECTRUM, both before and after being compressed using the WVQ program. Author

N93-24548*# TRW Systems Group, Redondo Beach, CA.
WAVELET ENCODING AND VARIABLE RESOLUTION PROGRESSIVE TRANSMISSION **c82**
Ronald P. Blanford *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 25-35 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

Progressive transmission is a method of transmitting and displaying imagery in stages of successively improving quality. The subsampled lowpass image representations generated by a wavelet transformation suit this purpose well, but for best results the order of presentation is critical. Candidate data for transmission are best selected using dynamic prioritization criteria generated from image contents and viewer guidance. We show that wavelets are not only suitable but superior when used to encode data for progressive transmission at non-uniform resolutions. This application does not preclude additional compression using quantization of highpass coefficients, which to the contrary results in superior image approximations at low data rates. Author

N93-24549*# Florida Univ., Gainesville. Dept. of Electrical Engineering.
FAST IMAGE DECOMPRESSION FOR TELEBROWSING OF IMAGES **c82**
Shaou-Gang Miaou and Julius T. Tou *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 37-48 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

Progressive image transmission (PIT) is often used to reduce the transmission time of an image telebrowsing system. A side effect of the PIT is the increase of computational complexity at the viewer's site. This effect is more serious in transform domain techniques than in other techniques. Recent attempts to reduce the side effect are futile as they create another side effect, namely, the discontinuous and unpleasant image build-up. Based on a practical assumption that image blocks to be inverse transformed are generally sparse, this paper presents a method to minimize both side effects simultaneously. Author

N93-24550*# University of North Texas, Denton. Dept. of Computer Science.
A SURVEY OF QUALITY MEASURES FOR GRAY-SCALE IMAGE COMPRESSION **c82**
Ahmet M. Eskicioglu and Paul S. Fisher *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 49-61 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

Although a variety of techniques are available today for gray-scale image compression, a complete evaluation of these techniques cannot be made as there is no single reliable objective criterion for measuring the error in compressed images. The traditional subjective criteria are burdensome, and usually inaccurate or inconsistent. On the other hand, being the most common objective criterion, the mean square error (MSE) does not have a good correlation with the viewer's response. It is now understood that in order to have a reliable quality measure, a representative model of the complex human visual system is required. In this paper, we survey and give a classification of the criteria for the evaluation of monochrome image quality. Author

N93-24551*# University of South Florida, Tampa. Center for Engineering and Medical Image Analysis.
DIGITAL MAMMOGRAPHY, CANCER SCREENING: FACTORS IMPORTANT FOR IMAGE COMPRESSION **c52**
Laurence P. Clarke, G. James Blaine (Washington Univ., Saint Louis, MO.), Kunio Doi (Chicago Univ., IL.), Martin J. Yaffe (Toronto Univ., Ontario.), Faina Shtern (National Cancer Inst., Bethesda, MD.), G. Stephen Brown (Research Triangle Inst., Research Triangle Park, NC.), Daniel L. Winfield (Research Triangle Inst., Research Triangle Park, NC.), and Maria Kallergi (University of South Florida, Tampa.) *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 63-74 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

The use of digital mammography for breast cancer screening poses several novel problems such as development of digital sensors, computer assisted diagnosis (CAD) methods for image noise suppression, enhancement, and pattern recognition, compression algorithms for image storage, transmission, and remote diagnosis. X-ray digital mammography using novel direct digital detection schemes or film digitizers results in large data sets and, therefore, image compression methods will play a significant role in the image processing and analysis by CAD techniques. In view of the extensive compression required, the relative merit of 'virtually lossless' versus lossy methods should be determined. A brief overview is presented here of the developments of digital sensors, CAD, and compression methods currently proposed and tested for mammography. The objective of the NCI/NASA Working Group on Digital Mammography is to stimulate the interest of the image processing and compression scientific community for this medical application and identify possible dual use technologies within the NASA centers. Author

N93-24552*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A STUDY OF VIDEO FRAME RATE ON THE PERCEPTION OF MOVING IMAGERY DETAIL **c82**
Richard F. Haines (RECOM Technologies, Inc., Moffett Field, CA.) and Sherry L. Chuang *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 75-84 (For primary document see N93-24544 08-59)
Avail: CASI HC A02/MF A02

The rate at which each frame of color moving video imagery is displayed was varied in small steps to determine what is the minimal acceptable frame rate for life scientists viewing white rats within a small enclosure. Two, twenty five second-long scenes (slow and fast animal motions) were evaluated by nine NASA principal investigators and animal care technicians. The mean minimum acceptable frame rate across these subjects was 3.9 fps both for the slow and fast moving animal scenes. The highest single trial frame rate averaged across all subjects for the slow and the fast scene was 6.2 and 4.8, respectively. Further research is called for in which frame rate, image size, and color/gray scale depth are covaried during the same observation period. Author

N93-24553*# Hughes STX, Inc., Greenbelt, MD. Cosmology Data Analysis Center.
SYSTEMS ASPECTS OF COBE SCIENCE DATA COMPRESSION **c82**
I. Freedman, E. Boggess, and E. Seiler *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 85-97 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

A general approach to compression of diverse data from large scientific projects has been developed and this paper addresses the appropriate system and scientific constraints together with the algorithrn development and test strategy. This framework has been implemented for the COsmic Background Explorer spacecraft (COBE) by retrofitting the existing VAS-based data management system with high-performance compression software permitting random access to the data. Algorithms which incorporate scientific knowledge and consume relatively few system resources are preferred over ad hoc methods. COBE exceeded its planned storage by a large and growing factor and the retrieval of data significantly affects the processing, delaying the availability of data for scientific usage and software test. Embedded compression software is planned to make the project tractable by reducing the data storage volume to an acceptable level during normal processing. Author

N93-24554*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROPOSED DATA COMPRESSION SCHEMES FOR THE GALILEO S-BAND CONTINGENCY MISSION **c82**
Kar-Ming Cheung and Kevin Tong *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 99-109 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

The Galileo spacecraft is currently on its way to Jupiter and its moons. In April 1991, the high gain antenna (HGA) failed to deploy as commanded. In case the current efforts to deploy the HGA fails, communications during the Jupiter encounters will be through one of two low gain antenna (LGA) on an S-band (2.3 GHz) carrier. A lot of effort has been and will be conducted to attempt to open the HGA. Also various options for improving Galileo's telemetry downlink performance are being evaluated in the event

that the HGA will not open at Jupiter arrival. Among all viable options the most promising and powerful one is to perform image and non-image data compression in software onboard the spacecraft. This involves in-flight re-programming of the existing flight software of Galileo's Command and Data Subsystem processors and Attitude and Articulation Control System (AACS) processor, which have very limited computational and memory resources. In this article we describe the proposed data compression algorithms and give their respective compression performance. The planned image compression algorithm is a 4 x 4 or an 8 x 8 multiplication-free integer cosine transform (ICT) scheme, which can be viewed as an integer approximation of the popular discrete cosine transform (DCT) scheme. The implementation complexity of the ICT schemes is much lower than the DCT-based schemes, yet the performances of the two algorithms are indistinguishable. The proposed non-image compression algorith is a Lempel-Ziv-Welch (LZW) variant, which is a lossless universal compression algorithm based on a dynamic dictionary lookup table. We developed a simple and efficient hashing function to perform the string search. Author

N93-24555*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

DATA COMPRESSION FOR THE CASSINI RADIO AND PLASMA WAVE INSTRUMENT **c82**

W. M. Farrell, D. A. Gurnett (Iowa Univ., Iowa City.), D. L. Kirchner (Iowa Univ., Iowa City.), W. S. Kurth (Iowa Univ., Iowa City.), and L. J. C. Woolliscroft (Sheffield Univ., England.) *In its* The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 111-120 (For primary document see N93-24544 08-59)

Avail: CASI HC A02/MF A02

The Cassini Radio and Plasma Wave Science experiment will employ data compression to make effective use of the available data telemetry bandwidth. Some compression will be achieved by use of a lossless data compression chip and some by software in a dedicated 80C85 processor. A description of the instrument and data compression system are included in this report. Also, the selection of data compression systems and acceptability of data degradation is addressed. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N93-22032* National Aeronautics and Space Administration. Pasadena Office, CA.

SELF-CHECKING ON-LINE TESTABLE STATIC RAM Patent

Savio N. Chau, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and David A. Rennels, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 6 Apr. 1993 13 p Filed 26 Jun. 1990 Supersedes N90-26518 (28 - 20, p 2904)

(NASA-Case-NPO-17939-1-CU; US-Patent-5,200,963; US-Patent-Appl-SN-543915; US-Patent-Class-371-68.1; US-Patent-Class-371-67.1; US-Patent-Class-365-131; Int-Patent-Class-G06F-15/40) Avail: US Patent and Trademark Office

This is a fault-tolerant random access memory for use in fault-tolerant computers. It comprises a plurality of memory chips each comprising a plurality of on-line testable and correctable memory cells disposed in rows and columns for holding individually addressable binary bits and provision for error detection incorporated into each memory cell for outputting an error signal whenever a transient error occurs therein. In one embodiment, each of the memory cells comprises a pair of static memory sub-cells for simultaneously receiving and holding a common binary data bit written to the memory cell and the error detection provision comprises comparator logic for continuously sensing and comparing the contents of the memory sub-cells to one another and for outputting the error signal whenever the contents do not match. In another embodiment, each of the memory cells comprises a static memory sub-cell and a dynamic memory sub-cell for simultaneously receiving and holding a common binary data bit written to the memory cell and the error detection provision comprises comparator logic for continuously sensing and comparing the contents of the static memory sub-cell to the dynamic memory sub-cell and for outputting the error signal whenever the contents do not match. Capability for correction of errors is also included.

Official Gazette of the U.S. Patent and Trademark Office

N93-22041*# Research Inst. for Computing and Information Systems, Houston, TX.

ADVANCED SOFTWARE DEVELOPMENT WORKSTATION. OOPSLA 1992 CONFERENCE. TRIP REPORT

Michel E. Izygon (Barrios Technology, Inc., Houston, TX.) 31 Dec. 1992 7 p Conference held in Vancouver, British Columbia, 19-22 Oct. 1992

(Contract NCC9-16; RICIS Proj. SR-02)

(NASA-CR-192811; NAS 1.26:192811) Avail: CASI HC A02/MF A01

This report summarizes the main trends observed at the Object Oriented Programming Systems, Languages, and Applications Conference held in Vancouver, British Columbia. This conference is the main object-oriented event that allows us to assess the dynamism of the technology and to meet the main actors of the field. It is an invaluable source of information for the advanced software development project. Author

N93-22471*# Eloret Corp., Sunnyvale, CA.

COMPUTER FACILITIES OPTIMIZATION STUDIES Final Technical Report, 1 Sep. 1986 - 31 Dec. 1992

Gilbert C. Lyle, S. Strauss-Duckett, and Terry C. Nelson 4 Mar. 1993 63 p

(Contract NCC2-441)

(NASA-CR-192702; NAS 1.26:192702) Avail: CASI HC A04/MF A01

A comprehensive plan was developed to determine the best options for integrating and upgrading various ADP systems in scientific research environments, such as at NASA Ames Research Center. Author

N93-22536# Interior Dept., Washington, DC.

APPARATUS AND METHOD FOR COMPUTER VISION MEASUREMENTS Patent Application

Steven G. Grannes, inventor (to Interior Dept.) 5 Nov. 1992 22 p

(PB93-135077; US-Patent-Appl-SN-971642; Pat-Appl-7-971642) Avail: CASI HC A03/MF A01

The invention related generally to computer vision systems and image processing methods used therein and, more specifically, to an improved system and method for interpreting coarsely textured surfaces and coarsely textured, irregular and layered particles such as pieces of ore conveyed by a conveyor. Author

N93-23042*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FIELD PROGRAMMABLE GATE ARRAYS: EVALUATION REPORT FOR SPACE-FLIGHT APPLICATION

Mike Sandoe, Mike Davarpanah, Kamal Soliman, Steven Suszko, and Susan Mackey 15 Sep. 1992 255 p

(Contract NAS7-918)

(NASA-CR-192796; NAS 1.26:192796; JPL-Publ-92-22) Avail: CASI HC A12/MF A03

Field Programmable Gate Arrays commonly called FPGA's are the newer generation of field programmable devices and offer more flexibility in the logic modules they incorporate and in how they are interconnected. The flexibility, the number of logic building blocks available, and the high gate densities achievable are why users find FPGA's attractive. These attributes are important in reducing product development costs and shortening the development cycle. The aerospace community is interested in incorporating this new generation of field programmable technology in space applications. To this end, a consortium was formed to evaluate the quality, reliability, and radiation performance of FPGA's. This report presents the test results on FPGA parts provided by ACTEL Corporation. Author (revised)

N93-23269# National Telecommunications and Information Administration, Annapolis, MD. Computer Services Div.

NTIA MICROCOMPUTER SPECTRUM ANALYSIS MODELS (MSAM). VERSION 4.0, AUGUST 1992

Aug. 1992 324 p

(PB93-108348) Avail: CASI HC A14/MF A03

The document is the computer software user's manual for the Microcomputer Spectrum Analysis Models (MSAM), version 4.0, August 1992. It includes the installation and operation instructions for the 14 radio

frequency communications engineering and spectrum management programs included in MSAM. Author

N93-23273# National Inst. of Standards and Technology, Gaithersburg, MD.
AUTOMATED TOOLS FOR TESTING COMPUTER SYSTEM VULNERABILITY
W. Timothy Polk Dec. 1992 42 p
(PB93-146025; NIST/SP-800/6) Avail: CASI HC A03/MF A01; SOD HC

The document discusses automated tools for testing computer system vulnerability. By analyzing factors affecting the security of a computer system, a system manager can identify common vulnerabilities stemming from administrative errors. Using automated tools, this process may examine the content and protections of hundreds of files on a multi-user system and identify subtle vulnerabilities. By acting on this information, system administrators can significantly reduce their systems' security exposure. Automated vulnerability testing tools are available for a wide variety of systems. Some tools are commercially available; others are available from other system administrators. Additional tools may be developed to address specific concerns for an organization's computer systems. The document examines basic requirements for vulnerability testing tools and describes the different functional classes of tools. Finally, the document offers general recommendations about the selection and distribution of such tools. GRA

N93-24491*# Old Dominion Univ., Norfolk, VA. Research Foundation.
PARALLEL-VECTOR UNSYMMETRIC EIGEN-SOLVER ON HIGH PERFORMANCE COMPUTERS Final Report
Duc T. Nguyen and Qin Jiangning Feb. 1993 34 p
(Contract NAS1-18584; RTOP 585-03-11-05)
(NASA-CR-191417; NAS 1.26:191417) Avail: CASI HC A03/MF A01

The popular QR algorithm for solving all eigenvalues of an unsymmetric matrix is reviewed. Among the basic components in the QR algorithm, it was concluded from this study, that the reduction of an unsymmetric matrix to a Hessenberg form (before applying the QR algorithm itself) can be done effectively by exploiting the vector speed and multiple processors offered by modern high-performance computers. Numerical examples of several test cases have indicated that the proposed parallel-vector algorithm for converting a given unsymmetric matrix to a Hessenberg form offers computational advantages over the existing algorithm. The time saving obtained by the proposed methods is increased as the problem size increased. Author (revised)

N93-24594*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CONVEX MINI MANUAL
Geoffrey M. Tennille and Lona M. Howser Feb. 1993 50 p Revised
(RTOP 505-90-53-02)
(NASA-TM-107564-Rev; CSCC-CX-1f; NAS 1.15:107564-Rev) Avail: CASI HC A03/MF A01

The use of the CONVEX computers that are an integral part of the Supercomputing Network Subsystems (SNS) of the Central Scientific Computing Complex of LaRC is briefly described. Features of the CONVEX computers that are significantly different than the CRAY supercomputers are covered, including: FORTRAN, C, architecture of the CONVEX computers, the CONVEX environment, batch job submittal, debugging, performance analysis, utilities unique to CONVEX, and documentation. This revision reflects the addition of the Applications Compiler and X-based debugger, CXdb. The document id intended for all CONVEX users as a ready reference to frequently asked questions and to more detailed information contained with the vendor manuals. It is appropriate for both the novice and the experienced user. Author

N93-24613 Carleton Univ., Ottawa (Ontario). Dept. of Systems and Computer Engineering.
HYPERSTRUCTURES AS COMPUTER ARCHITECTURES FOR HIGH PERFORMANCE MULTIPROCESSOR SYSTEMS Ph.D. Thesis
S. Boucouris Ottawa, Ontario Carleton Univ. 25 Sep. 1989 136 p
(ISBN-0-315-58975-2; CTN-93-60651) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

A theoretical framework is presented, along with a set of closed form expressions, for the evaluation of hypercube-like computer architectures (hyperstructures). The evaluation criteria include the diameter, average message path length, average message density, and fault tolerance. It is demonstrated that almost all configurations proposed in the literature are analyzable as special cases of the proposed scheme. A number of containment and partitioning properties of the binary hypercube are generalized to a large class of hypercube derivatives. In addition, the very large scale integration implementation of hyperstructures is considered. Algorithms are presented that make possible the generation of near-optimal layouts for any hypercube derivative. Results are presented that match or exceed the performance of configuration specific algorithms previously reported. The reduction of interconnection cost of a hyperstructure is also addressed. An approach is presented that makes possible the reduction of the interconnection cost in a controlled fashion. Author (CISTI)

N93-24621 Waterloo Univ. (Ontario).
VLSI ARCHITECTURAL SYNTHESIS FOR DSP CUSTOM APPLICATIONS Ph.D. Thesis
Baher S. Haroun Waterloo, Ontario Univ. of Waterloo 1989 204 p
(ISBN-0-315-57793-2; CTN-93-60657) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

A novel design methodology is presented for automated mapping of digital signal processing (DSP) algorithms into very large scale integration (VLSI) architectures. The methodology takes into account explicit algorithm requirements on throughput and latency, in addition to VLSI technology constraints on silicon area and power dissipation. Algorithm structure, design style of functional units and parallelism of the architecture are all explored in the design space. Algorithm structural transformations necessary to obtain high throughputs are developed. The synthesized architecture is a multiple bus, multiple functional unit processor matched to the implemented algorithm. The architecture is obtained by optimal or suboptimal graph theoretic transformations from an initial general architecture. The architecture has a linear topology and uses a lower number of interconnects and multiplexer inputs and has efficient data storage compared to other synthesized architectures with random topology having the same performance. The synthesized processor is a self-timed element externally while it is internally synchronous, suitable for multiprocessor implementations. The methodology is implemented in a design aid tool called SPAID. Results obtained using SPAID on different DSP algorithms compare favorably with other synthesis techniques. Author (CISTI)

N93-22172*# Naval Undersea Warfare Center, Newport, RI. Missiles Div.
MICRO-VIDEO DISPLAY WITH OCULAR TRACKING AND INTERACTIVE VOICE CONTROL
James E. Miller *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 227-234 Prepared for Foster-Miller Associates, Inc., Waltham, MA (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-24358# Joanneum Research Centre, Graz (Austria). Applied Systems Technology Inst.
DATAMIR: A PC-BASED COMPUTER SYSTEM FOR APPLICATION AT SPACE STATION MIR
M. B. Steller (Academy of Sciences, Graz, Austria.), V. Kosharinov (Institute of Biomedical Problems, Moscow, USSR.), S. Kasarinov (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), T. Stockhammer, C. Wagner, A. Wenzel, and P. Williere *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 117-120 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N93-22040*# Research Inst. for Computing and Information Systems, Houston, TX.
ADVANCED SOFTWARE DEVELOPMENT WORKSTATION. KNOWLEDGE BASE DESIGN: DESIGN OF KNOWLEDGE BASE FOR FLIGHT PLANNING APPLICATION
Michel E. Izygon (Barrios Technology, Inc., Houston, TX.) 31 Dec. 1992 16 p
(Contract NCC9-16; RICIS Proj. SR-02)
(NASA-CR-192818; NAS 1.26:192818) Avail: CASI HC A03/MF A01

The development process of the knowledge base for the generation of Test Libraries for Mission Operations Computer (MOC) Command Support focused on a series of information gathering interviews. These knowledge capture sessions are supporting the development of a prototype for evaluating the capabilities of INTUIT on such an application. the prototype includes functions related to POCC (Payload Operation Control Center) processing. It prompts the end-users for input through a series of panels and then generates the Meds associated with the initialization and the update of hazardous command tables for a POCC Processing TLIB.
Derived from text

N93-22042*# Research Inst. for Computing and Information Systems, Houston, TX.
ADVANCED SOFTWARE DEVELOPMENT WORKSTATION. COMPARISON OF TWO OBJECT-ORIENTED DEVELOPMENT METHODOLOGIES
Michel E. Izygon (Barrios Technology, Inc., Houston, TX.) 31 Dec. 1992 8 p
(Contract NCC9-16; RICIS Proj. SR-02)
(NASA-CR-192819; NAS 1.26:192819) Avail: CASI HC A02/MF A01

This report is an attempt to clarify some of the concerns raised about the OMT method, specifically that OMT is weaker than the Booch method in a few key areas. This interim report specifically addresses the following issues: (1) is OMT object-oriented or only data-driven?; (2) can OMT be used as a front-end to implementation in C++?; (3) the inheritance concept in OMT is in contradiction with the 'pure and real' inheritance concept found in object-oriented (OO) design; (4) low support for software life-cycle issues, for project and risk management; (5) uselessness of functional modeling for the ROSE project; and (6) problems with event-driven and simulation systems. The conclusion of this report is that both Booch's method and Rumbaugh's method are good OO methods, each with strengths and weaknesses in different areas of the development process.
Author (revised)

N93-22043*# Research Inst. for Computing and Information Systems, Houston, TX.
NetView TECHNICAL RESEARCH Final Technical Summary Report
Jan. 1993 8 p Prepared in cooperation with SofTech, Inc., Fairborn, OH
(Contract NCC9-16; RICIS Proj. SR-05)
(NASA-CR-192822; NAS 1.26:192822; CDRL-A002) Avail: CASI HC A02/MF A01

This is the Final Technical Report for the NetView Technical Research task. This report is prepared in accordance with Contract Data Requirements List (CDRL) item A002. NetView assistance was provided and details are presented under the following headings: NetView Management Systems (NMS) project tasks; WBAFB IBM 3090; WPAFB AMDAHL; WPAFB IBM 3084; Hill AFB; McClellan AFB AMDAHL; McClellan AFB IBM 3090; and Warner-Robins AFB.
Derived from text

N93-22074# Los Alamos National Lab., NM.
LOS ALAMOS HPDS: HIGH-SPEED DATA TRANSFER
M. W. Collins, J. Brewton, D. Cook, L. Jones, K. Kelly, D. L. Kluegel, D. Krantz, and C. Ramsey 1992 9 p Presented at the 12th IEEE Symposium on Mass Storage Systems, Monterey, CA, 25-29 Apr. 1992
(Contract W-7405-eng-36)
(DE93-003804; LA-UR-92-3600; CONF-9204217-1) Avail: CASI HC A02/MF A01

The Los Alamos High-Performance Data System (HPDS) is being developed to meet data storage and data access requirements of Grand Challenge and National Security problems running in a high-performance computing environment. HPDS is a new-generation data storage system in which storage devices are directly connected to a network, data is transferred directly between client machines and storage devices, and software distributed on workstations provides system management and control capabilities. Essential to the success of HPDS will be the ability to effectively use high performance parallel interface (HIPPI) networks and HIPPI-attached storage devices for high-speed data transfer. The peer-to-peer data transfer protocol that was developed for HPDS is addressed and the HPDS implementation approach is described. Because HPDS is under development, many changes will have taken place between the time this paper was written in October 1992 and its presentation in April 1993.
DOE

N93-22205* Computer Software Management and Information Center, Athens, GA.
COSMIC SOFTWARE CATALOG, 1993 Annual Report
1993 472 p
(NASA-CR-191005; NAS 1.26:191005) Avail: Issuing Activity (COSMIC, Athens, GA 30602-4272)

Descriptions of the software supplied by NASA's Computer Software Management and Information Center is included. Abstracts for over 1200 NASA-sponsored computer programs are included. Topics covered include the following: aeronautics, astronautics, chemistry and materials, engineering, geosciences, life sciences, mathematical and computer sciences, social sciences, and space sciences.
Author (revised)

N93-22332# Oak Ridge National Lab., TN.
THE DESIGN OF SCALABLE SOFTWARE LIBRARIES FOR DISTRIBUTED MEMORY CONCURRENT COMPUTERS
Jaeyoung Choi, D. W. Walker, and J. J. Dongarra 1992 14 p Presented at the CNRS-NSF Collaboration Workshop on Environments and Tools for Parallel Scientific Computing, St. Hilaire du Touvet, France, 7-8 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-003612; CONF-9209274-1) Avail: CASI HC A03/MF A01

This paper describes the design of ScaLAPACK, a scalable software library for performing dense and banded linear algebra computations on distributed memory concurrent computers. The specification of the data distribution has important consequences for interprocessor communication and load balance, and hence is a major factor in determining performance and scalability of the library routines. The block scattered data distribution is adopted as a simple, yet general-purpose, way of decomposing block-partitioned matrices. Distributed memory versions of the Level 3 BLAS provide an easy and convenient way of implementing the ScaLAPACK routines. Performance and scalability results for the ScaLAPACK LU factorization routine are presented, and potential uses for ScaLAPACK are discussed.
DOE

N93-22385*# Research Inst. for Computing and Information Systems, Houston, TX.
EXPLORATORY RESEARCH FOR THE DEVELOPMENT OF A COMPUTER AIDED SOFTWARE DESIGN ENVIRONMENT WITH THE SOFTWARE TECHNOLOGY PROGRAM Progress Summary Report, May 1989 - Apr. 1991
Charles Hardwick Apr. 1991 12 p
(Contract NCC9-16; RICIS Proj. SE-23)
(NASA-CR-192821; NAS 1.26:192821) Avail: CASI HC A03/MF A01

Field studies were conducted by MCC to determine areas of research of mutual interest to MCC and JSC. NASA personnel from the Information Systems Directorate and research faculty from UHCL/RICIS visited MCC in Austin, Texas to examine tools and applications under development in the MCC Software Technology Program. MCC personnel presented workshops in hypermedia, design knowledge capture, and design recovery on site at JSC for ISD personnel. The following programs were installed on workstations in the Software Technology Lab, NASA/JSC: (1) GERM (Graphic Entity Relations Modeler); (2) gIBIS (Graphic Issues Based Information System); and (3) DESIRE (Design Recovery tool). These applications were made available to NASA for inspection and evaluation.

Programs developed in the MCC Software Technology Program run on the SUN workstation. The programs do not require special configuration, but they will require larger than usual amounts of disk space and RAM to operate properly. Derived from text

N93-22391# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

INVESTIGATION OF COGNITION ACQUISITION USING NATURAL LANGUAGE CONVERSATIONAL PROCESS [UNTERSUCHUNGEN ZUR WISSENSAKQUISITION MITTELS NATURSPRACHLICHEM DIALOGVERFAHREN]

Klaus Brauser Sep. 1989 20 p In GERMAN Presented at DGLR e.V. Forschunginstitut fuer Anthropotechnik der FGAN e.V. 32nd Fachausschusssitzung, Ottobrunn, Germany, 10-20 Sep. 1989 Submitted for publication

(MBB-FE-315-S-PUB-0498; ETN-93-93437) Avail: CASI HC A03/MF A01

The object oriented language processing for cognition acquisition and reproduction was realized, using Knowledge Acquisition System Demonstrator (KASD) and an expert systems for problem taxonomy (ESAT). Both system similarities and differences are represented. It is shown that the methods of cognition acquisition presented, were developed in order to allow a natural conversational dialog between the user and the ESAT expert system, without coded or strongly modified entries. ESA

N93-22394# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

COMPUTER AIDED INTEGRATED PRODUCTION PLANNING IN UNIT PRODUCTION, AS REPRESENTED IN AIRCRAFT CONSTRUCTION [COMPUTERGESTUETZTE INTEGRIERTE PRODUKTIONSPLANUNG IN DER EINZELFERTIGUNG. DARGESTELLT AM FLUGZEUGBAU]

Werner Fischer Jun. 1990 53 p In GERMAN Presented at PPS, Wandel, Germany, 26-27 Jun. 1990

(MBB-FW-3-S-PUB-0439-A; ETN-93-93440) Avail: CASI HC A04/MF A01

It is shown that the utilization of technical products takes place by fluxes and processes which are similar to biological processes, in connection with information, energy, and material. Avionics and Computer Integrated Manufacturing (CIM) are the most important application fields. The three domains, product internal, product near, and product neutral information processing, used very different processes. Great rationalization and quality improvements are still expected for Computer Aided Software Engineering (CASE). The consequences of integrated information processing are reported. It is concluded that companies have to solve more or less integration tasks, according to the product complexity and the operating cycles. ESA

N93-22450 National Physical Lab., Teddington (England). Information Technology and Computing Div.

POSITION CALIBRATION SOFTWARE FOR THE FORM ASSESSMENT OF COMPLEX WORKPIECES

A. B. Forbes Jul. 1992 16 p

(NPL-DITC-203/92; ETN-93-93545) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

The use of a measurement strategy and position calibration software to overcome the difficulty in measuring many manufactured workpieces by a Coordinate Measuring Machine (CMM) is described. The difficulty arises because for any given orientation of the workpiece some of the important areas cannot be accessed by the CMM's probe. Three or more reference spheres are rigidly attached to the workpiece. Sets of measurements of the workpiece and the spheres are collected with the workpiece at locations and orientation convenient for measurement. The software tracks the changes in position by determining the frame of reference defined by the reference spheres at each stage and then combines the different sets of measurements to yield a composite data set from which an accurate assessment of the complete workpiece can be made. The method, which can be applied to a wide range of artefacts with minimal addition effort, is largely self calibrating which makes the measurements process straightforward. The software is self starting which makes it very simple to use. ESA

N93-22452 National Physical Lab., Teddington (England). Materials Metrology Div.

CREEPSIM-2: A SOFTWARE PACKAGE FOR NUMERICAL INTEGRATION OF 1ST ORDER DIFFERENTIAL EQUATIONS

S. Osgerby, A. Barbosa, and B. F. Dyson Jun. 1992 20 p Sponsored by Dept. of Trade and Industry

(NPL-DMM(A)-35; ETN-93-93547) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

The time dependent deformation and consequent fracture behavior of engineering materials under variable load and temperature can be modeled using a set of first order differential equations based upon state viables which are defined to represent the physical mechanisms of deformation and fracture. Usually, these equation sets cannot be solved analytically and a method of numerical integration is required. A software package, designated CREEPSIM-2, was developed to perform this task, which overcomes many limitations of an earlier program, CREEPSIM. The use of the program is described and examples of the screen display are given. Examples of the use of the package to model a number of different deformation and fracture mechanisms are given to illustrate the versatility of the modeling approach. ESA

N93-22473# Department of National Defence, Ottawa (Ontario). Research and Development Branch.

PLTPWR: A VERSATILE TOOL FOR GREYSCALE AND POWER SPECTRAL DISPLAY

Joseph B. Farrell Apr. 1992 78 p

(DREA-TC-92-306; CTN-93-60711) Avail: CASI HC A05/MF A01

The versatile plotting program PLTPWR is described. The program is designed to display both real and complex format power spectrum files and runs on Concurrent Computer Corporation 5000-6000 series and Digital Equipment VAX computers. PLTPWR has a powerful user interface which provides versatility in setting up parameters for calibration, display, and printing of power spectra. Some of the main features of PLTPWR are: a fully configurable display of power spectra, cross-power spectra, 1/3 octave spectra, coherence, and bearing data from Defence Research Establishment Atlantic (DREA) format files; re-display and printing of information contained in DREA format greyscale files; hardcopy output in postscript format of any displayed data; fully configurable greyscale calculations from input power spectrum files; up to 16 on-screen color displays of greyscale and/or spectral data (Concurrent 5000-6000 series only); hardcopy output from any computed greyscale data; and calibration, time averaging, and bin compression of power spectrum data. The program user interface and commands are explained, file formats are described, and procedures are given for configuring on-screen greyscale displays and implementing the program. Author (CISTI)

N93-22533# Sandia National Labs., Albuquerque, NM.

VIDEO ANIMATION SYSTEM OPERATORS MANUAL

J. F. Mareda Sep. 1992 48 p

(Contract DE-AC04-76DP-00789)

(DE93-007425; SAND-92-1624) Avail: CASI HC A03/MF A01

This document describes the components necessary to put together a video animation system. It is primarily intended for use at Sandia National Laboratories as it describes the components used in systems at Sandia. The main document covers the operation of the equipment in some detail and is intended for either the system maintainer or an advanced user. There is an appendix for each of the three systems in use by the Engineering Sciences Directorate which contain instructions for the general user. DOE

N93-22601*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A NASA-WIDE APPROACH TOWARD COST-EFFECTIVE, HIGH-QUALITY SOFTWARE THROUGH REUSE

Charlotte O. Scheper, ed. (Research Triangle Inst., Research Triangle Park, NC.) and Kathryn A. Smith, ed. Jan. 1993 125 p Proceedings of the Second NASA Workshop on Software Reuse held at Research Triangle Park, NC, 5-6 May 1992

(RTOP 505-64-10-02)

(NASA-CP-10115; NAS 1.55:10115) Avail: CASI HC A06/MF A02

NASA Langley Research Center sponsored the second Workshop on NASA Research in Software Reuse on May 5-6, 1992 at the Research Triangle Park, North Carolina. The workshop was hosted by the Research

Triangle Institute. Participants came from the three NASA centers, four NASA contractor companies, two research institutes and the Air Force's Rome Laboratory. The purpose of the workshop was to exchange information on software reuse tool development, particularly with respect to tool needs, requirements, and effectiveness. The participants presented the software reuse activities and tools being developed and used by their individual centers and programs. These programs address a wide range of reuse issues. The group also developed a mission and goals for software reuse within NASA. This publication summarizes the presentations and the issues discussed during the workshop. Author

N93-22701*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONJUNCTIVE PROGRAMMING: AN INTERACTIVE APPROACH TO SOFTWARE SYSTEM SYNTHESIS
Robert C. Tausworthe 1 Aug. 1992 136 p
(Contract NAS7-918)
(NASA-CR-192798; NAS 1.26:192798; JPL-Publ-92-12) Avail: CASI HC A07/MF A02

This report introduces a technique of software documentation called conjunctive programming and discusses its role in the development and maintenance of software systems. The report also describes the conjoin tool, an adjunct to assist practitioners. Aimed at supporting software reuse while conforming with conventional development practices, conjunctive programming is defined as the extraction, integration, and embellishment of pertinent information obtained directly from an existing database of software artifacts, such as specifications, source code, configuration data, link-edit scripts, utility files, and other relevant information, into a product that achieves desired levels of detail, content, and production quality. Conjunctive programs typically include automatically generated tables of contents, indexes, cross references, bibliographic citations, tables, and figures (including graphics and illustrations). This report presents an example of conjunctive programming by documenting the use and implementation of the conjoin program. Author (revised)

N93-22720# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
MOTIF, THE BASICS: AN OVERVIEW OF THE WIDGET SET
F. R. McClurg Oct. 1992 30 p
(Contract DE-AC07-76ID-01570)
(DE93-005273; EGG-CODP-10473) Avail: CASI HC A03/MF A01

The Motif library provides programmers with a rich set of tools for building a graphical user interface with a three-dimensional appearance and a consistent method of interaction for controlling an Unix application. This Xt-based, high-level library presents an 'object-oriented' approach to program design for programmers and allows end-users the flexibility to modify attributes of the interface. DOE

N93-22740# California Univ., Berkeley. Lawrence Berkeley Lab.
SOFTWARE ENGINEERING: WHAT DO EXPERIMENTS NEED?
S. C. Loken Sep. 1992 4 p Presented at the 10th Conference on Computing in High Energy Physics, Annecy, France, 21-25 Sep. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004767; LBL-32937; CONF-920966-23) Avail: CASI HC A01/MF A01

This paper will review the use of software engineering in High Energy Physics experiments and will suggest ways in which that use will change significantly in the future. In principle, experiments do not need software engineering. We can verify this by looking at a long series of experiments that have succeeded without it. Some experiments that have tried to apply formal engineering methods have given them up before the software was complete. Future experiments, however, face many new challenges in the larger data samples, larger and more distributed collaborations, and longer time scales. In addition, new tools are available to aid in the development of complex software systems. It is appropriate, therefore, to examine whether there is now a better match between software engineering and the needs of experiments. DOE

N93-22778# California Univ., Berkeley. Lawrence Berkeley Lab.
HIGH SPEED, WIDE AREA DISTRIBUTED COMPUTING FOR SCIENTIFIC IMAGING
W. E. Johnston, V. L. Jacobson, S. C. Loken, D. W. Robertson, and B. L. Tierney Sep. 1992 4 p Presented at the 10th Conference on Computing in High Energy Physics, Annecy, France, 21-25 Sep. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004727; LBL-32935; CONF-920966-22) Avail: CASI HC A01/MF A01

A scenario for a fully distributed computing environment in which computing, storage, and I/O elements are configured on demand into 'virtual systems' that are optimal for the solution of a particular problem is presented. An experiment that illustrates some of the elements and issues of this scenario is also presented. The goal is to make the most powerful computing systems those that are logically assembled from network based components, and to make those systems available independent of the geographic location of the constituent elements. DOE

N93-22798*# Auburn Univ., AL. Dept. of Computer Science and Engineering.
UPDATE OF GRASP/Ada REVERSE ENGINEERING TOOLS FOR Ada Final Report, 1 Jul. - 31 Dec. 1992
James H. Cross, II 31 Dec. 1992 54 p
(Contract NAS8-39131)
(NASA-CR-192465; NAS 1.26:192465; CSE-92-10) Avail: CASI HC A04/MF A01

The GRASP/Ada project (Graphical Representations of Algorithms, Structures, and Processes for Ada) has successfully created and prototyped a new algorithmic level graphical representation of Ada software, the Control Structure Diagram (CSD). The primary impetus for creation of the CSD was to improve the comprehension efficiency of Ada software and, as a result, improve reliability and reduce costs. The emphasis was on the automatic generation of the CSD from Ada PDL or source code to support reverse engineering and maintenance. The CSD has the potential to replace traditional prettyprinted Ada source code. In Phase 1 of the GRASP/Ada project, the CSD graphical constructs were created and applied manually to several small Ada programs. A prototype (Version 1) was designed and implemented using FLEX and BISON running under VMS on a VAS 11-780. In Phase 2, the prototype was improved and ported to the Sun 4 platform under UNIX. A user interface was designed and partially implemented using the HP widget toolkit and the X Windows System. In Phase 3, the user interface was extensively reworked using the Athena widget toolkit and X Windows. The prototype was applied successfully to numerous Ada programs ranging in size from several hundred to several thousand lines of source code. Following Phase 3, the prototype was evaluated by software engineering students at Auburn University and then updated with significant enhancements to the user interface including editing capabilities. Version 3.2 of the prototype was prepared for limited distribution to facilitate further evaluation. The current prototype provides the capability for the user to generate CSD's from Ada PDL or source code in a reverse engineering as well as forward engineering mode with a level of flexibility suitable for practical application. Author (revised)

N93-22816 National Physical Lab., Teddington (England). Information Technology and Computing Div.
SURVEY OF BENCHMARKS
E. R. Brocklehurst Nov. 1991 32 p
(NPL-DITC-192/91; ETN-93-93544) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

An extensive survey of computer benchmarks applicable to vector and parallel processor systems is presented. A description of each benchmark encountered is given. The various methods of benchmark specification and the different types of benchmarks are described. Some conclusions are drawn and suggestions as to how benchmarks can be made more reliable, more usable, and more useful, are made. The problems of distributed memory MIMD machines are discussed. ESA

N93-22979# Sandia National Labs., Livermore, CA.
A COMPARATIVE STUDY OF PRECONDITIONED LANCZOS METHODS FOR NONSYMMETRIC LINEAR SYSTEM
C. H. Tong Sep. 1992 121 p
(Contract DE-AC04-76DR-00789)
(DE93-006453; SAND-91-8240B) Avail: CASI HC A06/MF A02

Many important scientific applications require the solution of very large and sparse nonsymmetric linear systems. Hence, there has been great interest in the development of robust and efficient solvers. In recent years, the class of Krylov subspace methods has emerged as the most popular iterative solution schemes. Coupled with effective preconditioning, these

methods show fast convergence for many problems. However, these methods are not guaranteed to converge, especially for many difficult problems that are strongly nonsymmetric, near singular, and indefinite. In this report, we survey some recent developments of Krylov subspace methods which are based on the Lanczos procedure. These methods have been implemented and tested on a variety of problems. Extensive numerical results are presented and discussed. DOE

N93-23000# Allied-Signal Aerospace Co., Kansas City, MO.
HIGH RESOLUTION THREE-DIMENSIONAL SOLDER JOINT MEASUREMENT SYSTEM EVALUATION
M. A. Trent Nov. 1992 38 p
(Contract DE-AC04-76DP-00613)
(DE93-005840; KCP-613-4939) Avail: CASI HC A03/MF A01

A state of the art three-dimensional vision system was evaluated to assess compatibility, operation, programming and repeatability. The system was found to be highly accurate in comparison to manual visual inspection. The ability to quantify product differences based on physical measurements is the basis for recommending procurement and implementation at the Kansas City Division. DOE

N93-23058*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ISOMORPHIC ROUTING ON A TOROIDAL MESH Final Report
Weizhen Mao and David M. Nicol Washington Feb. 1993 25 p Submitted for publication Sponsored by NASA. Langley Research Center
(Contracts NAS1-19480; NAS1-18605; RTOP 505-90-52-01)
(NASA-CR-191430; NAS 1.26:191430; ICASE-93-5) Avail: CASI HC A03/MF A01

We study a routing problem that arises on SIMD parallel architectures whose communication network forms a toroidal mesh. We assume there exists a set of k message descriptors (xi, yi), where (xi, yi) indicates that the ith message's recipient is offset from its sender by xi hops in one mesh dimension, and yi hops in the other. Every processor has k messages to send, and all processors use the same set of message routing descriptors. The SIMD constraint implies that at any routing step, every processor is actively routing messages with the same descriptors as any other processor. We call this isomorphic routing. Our objective is to find the isomorphic routing schedule with least makespan. We consider a number of variations on the problem, yielding complexity results from O(k) to NP-complete. Most of our results follow after we transform the problem into a scheduling problem, where it is related to other well-known scheduling problems. Author

N93-23089 Martec Ltd., Halifax (Nova Scotia).
VASGEN: A FINITE ELEMENT MODEL GENERATION PROGRAM FOR VAST. USER'S MANUAL, VERSION 4.0
E. J. Crocker and M. W. Chernuka May 1991 212 p
(Contract DSS-W7707-8-0145)
(DREA-CR-91-447) Avail: Issuing Activity (Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada)

A program called VASGEN for generating finite element models through the use of parametric cubic modelling based on cubic curves, Coons patches and tri-cubic hyperpatches is presented. The program is designed to produce geometry and element connectivity data for use by the finite element analysis program VAST. It provides capabilities for mesh generation, the linking of discrete meshed curves, patches and hyperpatches, and bandwidth h minimization. The program graphics facilities allow the user to plot both the geometric model and the finite element model. Notable enhancements within version 4.0 of VASGEN include modelling using parametric cubic splines; generation of patch intersection curves; generation of degenerate entities; meshing with axisymmetric elements; and grid biasing toward entity boundaries and/or stiffener locations. Modelling recommendations and example models generated with VASGEN are provided. Author

N93-23091# Calspan-Buffalo Univ. Research Center, NY.
NATURAL LANGUAGE PROCESSING SYSTEMS EVALUATION WORKSHOP Final Report, May - Nov. 1991
Jeannette G. Neal and Sharon M. Walter Dec. 1991 170 p Workshop held in Berkeley, CA, 18 Jun. 1991
(Contract F30602-88-D-0026)
(RL-TR-91-362) Avail: CASI HC A08/MF A02

The Natural Language Processing Systems Evaluation Workshop, sponsored by Rome Laboratory and attended by over 60 people, was held in conjunction with the 29th Annual Meeting of the Association for Computational Linguistics (ACL) on 18 June 1991 at the Berkeley Campus of the University of California. The Workshop provided a forum for computational linguists to discuss current evaluation efforts and activities, research progress, and new approaches; promoted scientific interchange on important evaluation issues; and generated recommendations and directions for future investigations in the evaluation area. The papers in this report are formal records of the presentations made at the Workshop. Author

N93-23092# Department of Defense, Washington, DC.
PROCEEDINGS: DOD SOFTWARE TECHNOLOGY STRATEGY PUBLIC FORUM
2 Apr. 1992 292 p Proceedings held in Falls Church, VA, 31 Mar. - 2 Apr. 1992
Avail: CASI HC A13/MF A03

DoD Software Technology Strategy (SWTS) Forum succeeded in its primary objectives to: obtain feedback which will help to improve the SWTS and refine a shared vision of DoD's software technology future. The Forum was preceded by the distribution of a draft SWTS document in January 1992. Reviewers were requested to provide initial comments on the draft. The SWTS working group received over 450 comments, and used these comments to help structure the Forum presentations and issue discussions. These Proceedings provide a record of the Forum activity. Topics covered include: software technology strategy; software and systems engineering; human-computer interactions; artificial intelligence and intelligent systems; parallel/distributed software; fault tolerance software; and high assurance software. CASI

N93-23099*# Hawaii Univ., Maui. Dept. of Electrical Engineering.
SUBOPTIMUM DECODING OF BLOCK CODES
Shu Lin and Tadao Kasami (Osaka Univ., Toyonaka, Japan.) 15 Oct. 1991 14 p
(Grant NAG5-931)
(NASA-CR-192342; NAS 1.26:192342; NASA-91-004) Avail: CASI HC A03/MF A01

This paper investigates a class of decomposable codes, their distance and structural properties. it is shown that this class includes several classes of well known and efficient codes as subclasses. Several methods for constructing decomposable codes or decomposing codes are presented. A two-stage soft decision decoding scheme for decomposable codes, their translates or unions of translates is devised. This two-stage soft-decision decoding is suboptimum, and provides an excellent trade-off between the error performance and decoding complexity for codes of moderate and long block length. Author

N93-23134*# Analex Corp., Brook Park, OH.
ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE HIGH BURST RATE LINK EVALUATION TERMINAL COMMUNICATION PROTOCOL SOFTWARE USER'S GUIDE, VERSION 1.0 Final Report
Richard C. Reinhart Mar. 1993 48 p
(Contract NAS3-25776; RTOP 679-50-0A)
(NASA-CR-189162; E-7657; NAS 1.26:189162) Avail: CASI HC A03/MF A01

The Communication Protocol Software was developed at the NASA Lewis Research Center to support the Advanced Communications Technology Satellite High Burst Rate Link Evaluation Terminal (ACTS HBR-LET). The HBR-LET is an experimenters terminal to communicate with the ACTS for various experiments by government, university, and industry agencies. The Communication Protocol Software is one segment of the Control and Performance Monitor (C&PM) Software system of the HBR-LET. The Communication Protocol Software allows users to control and configure the Intermediate Frequency Switch Matrix (IFSM) on board the ACTS to yield a desired path through the spacecraft payload. Besides IFSM control, the C&PM Software System is also responsible for instrument control during HBR-LET experiments, uplink power control of the HBR-LET to demonstrate power augmentation during signal fade events, and data

display. The Communication Protocol Software User's Guide, Version 1.0 (NASA CR-189162) outlines the commands and procedures to install and operate the Communication Protocol Software. Configuration files used to control the IFSM, operator commands, and error recovery procedures are discussed. The Communication Protocol Software Maintenance Manual, Version 1.0 (NASA CR-189163, to be published) is a programmer's guide to the Communication Protocol Software. This manual details the current implementation of the software from a technical perspective. Included is an overview of the Communication Protocol Software, computer algorithms, format representations, and computer hardware configuration. The Communication Protocol Software Test Plan (NASA CR-189164, to be published) provides a step-by-step procedure to verify the operation of the software. Included in the Test Plan is command transmission, telemetry reception, error detection, and error recovery procedures. Author (revised)

N93-23173*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
APPLICATIONS AND ACCURACY OF THE PARALLEL DIAGONAL DOMINANT ALGORITHM Final Report
Xian-He Sun Washington Feb. 1993 28 p Submitted for publication Sponsored by NASA, Langley Research Center
(Contract NAS1-19480; RTOP 505-90-52-01)
(NASA-CR-191431; NAS 1.26:191431; ICASE-93-6) Avail: CASI HC A03/MF A01

The Parallel Diagonal Dominant (PDD) algorithm is a highly efficient, ideally scalable tridiagonal solver. In this paper, a detailed study of the PDD algorithm is given. First the PDD algorithm is introduced. Then the algorithm is extended to solve periodic tridiagonal systems. A variant, the reduced PDD algorithm, is also 'proposed. Accuracy analysis is provided for a class of tridiagonal systems, the symmetric, and anti-symmetric Toeplitz tridiagonal systems. Implementation results show that the analysis gives a good bound on the relative error, and the algorithm is a good candidate for the emerging massively parallel machines. Author

N93-23196 University of South Florida, Tampa.
MODELING AND ANALYSIS OF SOFTWARE RELIABILITY Ph.D. Thesis
Nalina Suresh 1992 108 p
Avail: Univ. Microfilms Order No. DA9235086

This dissertation investigates the modeling of software reliability and its application to software development process. First, an extension of a Bayes empirical-Bayes model for software reliability is considered by assuming time between failures to be Weibull random variables. Then a software reliability growth model based on a nonhomogeneous Poisson process with Weibull intensity function is introduced. An Unbiased estimate of failure rate is used for reliability prediction. This result is compared with predictions by models which fit into the general framework of Bayes Empirical-Bayes problem. the model which assumes that time between failures has an exponential distribution and the model which assumes the process generating failures to be nonhomogeneous Poisson process with special type of intensity function have been used for comparison. An extension of Nonhomogeneous Poisson Process is derived. This extension considers the intensity function as a function of time, number of errors removed, and the time since the last failure. To illustrate the usefulness of above extension and optimization model for software development process is formulated. This model determines the optimal allocation of resources throughout the development that maximizes the reliability of the software for a given cost. Then a linear programming model is formulated to maximize the quality of the software within the budget. Some possible extensions are mentioned. Dissert. Abstr.

N93-23248*# Brown Univ., Providence, RI. Div. of Engineering.
SYSTEM IDENTIFICATION AND MODEL REDUCTION USING MODULATING FUNCTION TECHNIQUES
Yan Shen Mar. 1993 195 p
(Grant NAG1-1065)
(NASA-CR-192807; NAS 1.26:192807; LEMS-117) Copyright Avail: CASI HC A09/MF A03

Weighted least squares (WLS) and adaptive weighted least squares (AWLS) algorithms are initiated for continuous-time system identification using Fourier type modulating function techniques. Two stochastic signal models are examined using the mean square properties of the stochastic calculus: an equation error signal model with white noise residuals, and a more realistic white measurement noise signal model. The covariance matrices in each model are shown to be banded and sparse, and a joint likelihood cost function is developed which links the real and imaginary parts of the modulated quantities. The superior performance of above algorithms is demonstrated by comparing them with the LS/MFT and popular predicting error method (PEM) through 200 Monte Carlo simulations. A model reduction problem is formulated with the AWLS/MFT algorithm, and comparisons are made via six examples with a variety of model reduction techniques, including the well-known balanced realization method. Here the AWLS/MFT algorithm manifests higher accuracy in almost all cases, and exhibits its unique flexibility and versatility. Armed with this model reduction, the AWLS/MFT algorithm is extended into MIMO transfer function system identification problems. The impact due to the discrepancy in bandwidths and gains among subsystem is explored through five examples. Finally, as a comprehensive application, the stability derivatives of the longitudinal and lateral dynamics of an F-18 aircraft are identified using physical flight data provided by NASA. A pole-constrained SIMO and MIMO AWLS/MFT algorithm is devised and analyzed. Monte Carlo simulations illustrate its high-noise rejecting properties. Utilizing the flight data, comparisons among different MFT algorithms are tabulated and the AWLS is found to be strongly favored in almost all facets. Author

N93-23327# Fermi National Accelerator Lab., Batavia, IL.
REDUCING COMMUNICATION INEFFICIENCIES FOR A FLEXIBLE PROGRAMMING PARADIGM
M. Fischler, M. Gao, G. Hockney, M. Isely, and M. Uchima Nov. 1992 4 p Presented at the LATTICE 1992 Lattice Field Theory, Amsterdam, Netherlands, 15-19 Sep. 1992
(Contract DE-AC02-76CH-03000)
(DE93-005670; FNAL/C-92/324; CONF-9209276-8) Avail: CASI HC A01/MF A01

The ACPMAPS system at Fermilab has been upgraded to 50 GF by inserting new CPU modules, based on the Intel i860. This ten-fold increase in power, utilizing the identical communications backbone, places the system in a different realm: The transfer latency and overheads are now greater, relative to the cost of a floating point operation. We explore the consequences for programs written using CANOPY, which relies on low communications latencies. We present techniques for alleviating the efficiency decrease, by coalescing transfers, without abandoning the considerable advantages of the CANOPY paradigm. DOE

N93-23345# Department of National Defence, Ottawa (Ontario). Research and Development Branch.
SPRING2: HELICAL COMPRESSION SPRING GEOMETRY GENERATOR PROGRAM MANUAL
David C. Stredulinsky Jul. 1992 60 p
(DREA-TC-92-314; CTN-93-60714) Avail: CASI HC A04/MF A01

Documentation and operating instructions are provided for the FORTRAN computer program SPRING2. This code is used to generate the geometry of a helical compression spring with closed ground ends. The primary output of the code is a PATRAN session file which can be run in PATRAN to generate PATRAN Phase 1 (geometry) and Phase 2 (finite element) models automatically. A PATRAN neutral file is then created which the program PATVAS can convert to a VAST finite element model. The program can be used to generate a session file for a full solid finite element model, constructed with 20-noded hexahedral elements, or for a simplified line model in which the spring helix is modelled with a string of beam elements following the spring wire center line. Author (CISTI)

N93-23358# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
TOWARDS COMPUTER-SUPPORTED CREATIVE DESIGN BASED ON ALTSHULLER'S THEORY OF INVENTIVE PROBLEM SOLVING
F. Dikker, G. B. Leemeijer, P. M. Wognum, and N. J. I. Mars 1 Jul. 1992 38 p
(Memo-INF-92-49; UT-KBS-92-25; ETN-93-93203) Copyright Avail: CASI HC A03/MF A01

Altshuller's Algorithm of Inventive Problem Solving (AIPS) is critically discussed. To determine whether this algorithm is amenable to a computer implementation, a conceptual model of the algorithm was constructed. Part of this model is a knowledge structure in which the different knowledge

sources that support the algorithm are integrated. This knowledge structure is intended as a basis for a joint research program on automated creative design. ESA

N93-23359# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.

BIPARTITIONING OF LOTOS SPECIFICATIONS M.S. Thesis

Peter J. Broekroelofs 1992 86 p

(Memo-INF-92-50; TIOS-92-22; ETN-93-9324) Copyright Avail: CASI HC A05/MF A01

Algorithms for the bipartitioning of Basic LOTOS specifications are developed. The main advantage of these algorithms is that they preserve structure, that is they do not expand the specification. The algorithms are implemented in a software tool, called CLEAVER. A designer makes a partitioning of observable and nonobservable gates of specification and the tool then automatically derives the target specification. An exercise shows the practical use of the bipartitioning algorithms and the tool. In this exercise a simple but fairly complete message transfer service is bipartitioned into a protocol. The service is written in the constraint oriented specification style, while the derived protocol is resource oriented. The resources in the protocol are structured in the constraint oriented style, as a result of the preserving of the service structure. With CLEAVER, the service can be bipartitioned in one step. Deriving protocols from services is one of the important uses of the bipartitioning method. Other applications are restructuring and modularization of a design and the derivation of Upper and Lower Testers for conformance testing. ESA

N93-23432*# Computer Sciences Corp., Hampton, VA.

LARCRIM USER'S GUIDE, VERSION 1.0

John S. Davis and William J. Heaphy Jan. 1993 99 p

(Contract NAS1-19038; RTOP 505-90-53-02)

(NASA-CR-191416; NAS 1.26:191416; TAO-60306) Avail: CASI HC A05/MF A02

LARCRIM is a relational database management system (RDBMS) which performs the conventional duties of an RDBMS with the added feature that it can store attributes which consist of arrays or matrices. This makes it particularly valuable for scientific data management. It is accessible as a stand-alone system and through an application program interface. The stand-alone system may be executed in two modes: menu or command. The menu mode prompts the user for the input required to create, update, and/or query the database. The command mode requires the direct input of LARCRIM commands. Although LARCRIM is an update of an old database family, its performance on modern computers is quite satisfactory. LARCRIM is written in FORTRAN 77 and runs under the UNIX operating system. Versions have been released for the following computers: SUN (3 & 4), Convex, IRIS, Hewlett-Packard, CRAY 2 & Y-MP. Author

N93-23436# Illinois Univ., Urbana-Champaign. Dept. of Civil Engineering.

APPLICATIONS OF PARALLEL AND VECTOR ALGORITHMS IN NONLINEAR STRUCTURAL DYNAMICS USING THE FINITE ELEMENT METHOD Ph.D. Thesis, 1991

Brian E. Healy, David A. Pecknold, and Robert H. Dodds, Jr. Sep. 1992 317 p Sponsored in part by Illinois Dept. of Commerce and Community Affairs

(Contract DE-FG02-85ER-25001)

(PB93-142438; UILU-ENG-92-2011; Structural Research Ser-571) Avail: CASI HC A14/MF A03

The research is directed toward the numerical analysis of large, three dimensional, nonlinear dynamic problems in structural and solid mechanics. Such problems include those exhibiting large deformations, displacements, or rotations, those requiring finite strain plasticity material models that couple geometric and material nonlinearities, and those demanding detailed geometric modeling. A finite element code was developed, designed around the 3D isoparametric family of elements, using a Total Lagrangian formulation and implicit integration of the global equations of motion. The research was conducted using the Alliant FX/8 and Convex C240 supercomputers. The research focuses on four main areas: development of element computation algorithms that exploit the inherent opportunities for concurrency and vectorization present in the finite element method; comparison of the preconditioned conjugate gradient method to a representative direct solver; investigation of various nonlinear solution algorithms, such as modified Newton-Raphson, secant-Newton, and nonlinear preconditioned conjugate gradient; and discovery of an accurate, robust finite strain plasticity material model. GRA

N93-23449# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

TAMING CHAOTIC CIRCUITS Ph.D. Thesis

Elizabeth Bradley Sep. 1992 191 p

(Contract N00014-89-J-3202; NSF MIP-90-011651)

(AD-A259495; AI-TR-1388) Avail: CASI HC A09/MF A02

Control algorithms that exploit chaotic behavior and its precursors can vastly improve the performance of many practical and useful systems. Phase-locked loops, for example, are normally designed using linearization. This approximation hides the global dynamics that lead to lock and capture range limits. Design techniques that are equipped to exploit the real nonlinear and chaotic nature of the device can loosen these limitations. The program Perfect Moment is built around a collection of such techniques. Given a differential equation, a control parameter, and two state-space points, the program explores the system's behavior, automatically choosing interesting and useful parameter values and constructing state-space portraits at each one. It then chooses a set of trajectory segments from those portraits, uses them to construct a composite path between the objectives, and finally causes the system to follow that path by switching the parameter value at the segment junctions. Rules embodying theorems and definitions from nonlinear dynamics are used to limit computational complexity by identifying areas of interest and directing and focusing the mapping and search on these areas. Even so, these processes are computationally intensive. However, the sensitivity of a chaotic system's state-space topology to the parameters of its equations and the sensitivity of the paths of its trajectories to state perturbations make this approach rewarding in spite of its computational demands. GRA

N93-23463# Mitre Corp., Bedford, MA.

A NEW PROCESS FOR ACQUIRING SOFTWARE ARCHITECTURE

Thomas F. Saunders, Barry M. Horowitz, and Matt L. Mleziva Nov. 1992 26 p

(AD-A259487; M-92B0000126) Avail: CASI HC A03/MF A01

Military systems must be able to change to accommodate new mission needs, threats, and technology. At the same time, military systems are being developed with budgets that are more and more limited. It is necessary to find ways to keep costs down and to maximize adaptability - for new systems and for extensions to existing systems that must be preserved. A system's software architecture is a key determinant of the system's adaptability. A well-conceived and well-maintained architecture allows reusable components to be included in the original development, custom components to be smoothly integrated via standard interface protocols, and improved components to be incorporated as replacements or enhancements are needed. To be useful, the software architecture must first be articulated and include provisions for change; second, it must be controlled and maintained throughout the system's life cycle. A process that can be used to ensure that system acquisitions include attention to the software architecture is defined. Author (revised)

N93-23467# Army Missile Command, Redstone Arsenal, AL. Guidance and Control Directorate.

A FUZZY LOGIC CONTROLLER SYSTEM Final Report, period ending Feb. 1992

G. P. Bradford Nov. 1992 58 p

(AD-A259723; AD-E951943, :; AMSMI/TR-RD-GC-92-26) Avail: CASI HC A04/MF A01

Fuzzy set theory allows for a relatively straightforward method of working with uncertain or imprecise data. Fuzzy logic makes use of this theory by providing a methodology of applying rules to this data. A short discussion of fuzzy set theory followed by a discussion of the system simulated is presented. A simple feedback system is used to illustrate the application of fuzzy logic. The system simulated is a simplified model of a turret whose position is to be controlled. The results of the simulation are shown and elaborated on, followed by a discussion of potential applications for fuzzy controllers and expert systems. As an appendix, the computer source code used to implement the simulation is presented and discussed. GRA

N93-23638# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.

TOWARDS A VISION ALGORITHM COMPILER FOR RECOGNITION OF PARTIALLY OCCLUDED 3-D OBJECTS

Mark D. Wheeler and Katsushi Ikeuchi 20 Nov. 1992 56 p

(Contract F33615-90-C-1465; ARPA Order 7597)

(AD-A259711; CMU-CS-92-185) Avail: CASI HC A04/MF A01

Our goal is to develop a model-based vision system that is capable of recognizing 3-D objects in range images in spite of partial occlusion of the objects. We present new methods for object recognition and localization and describe the implementation and performance of these methods in our Vision Algorithm Compiler (VAC) model-based vision system. The VAC is given a sensor model and a set of geometric object models and generates a recognition/localization program for the specified objects in images from the specified sensor. Our recognition algorithm is based on the hypothesize-and-verify paradigm. We use the sensor-modeling approach to build accurate models of our prior-knowledge constraints that account for constraints due to sensor characteristics feature-extraction algorithm behavior, model geometry, and the effects of partial occlusion. We phrase the hypothesis-generation process as a search for the most likely set of hypotheses based on our prior knowledge--in contrast to typical constrained combinatorial searches. GRA

N93-23659# Naval Research Lab., Washington, DC.

THE ECA CRITICAL REQUIREMENTS MODEL Final Report

Charles N. Payne, Jr., David M. Mihelcic, Andrew P. Moore, and Kenneth J. Hayman 28 Dec. 1992 12 p

(AD-A259682; NRL/FR/5542-92-9528) Avail: CASI HC A03/MF A01

The ECA is an embedded computing device that processes message traffic for a network that must enforce end-to-end user message confidentiality. The ECA uses a commercial, off-the-shelf cryptographic device to transform sensitive data from the Red Domain of the network so that it can be transmitted over the untrusted communication links of the Black Domain. For transmission purposes, certain parts of a message, namely the message header, must be bypassed around the cryptographic device. The primary critical requirement for the ECA, Restricted Red-to-Black Flow (RRTBF), requires that the bypassed portion of each message must satisfy certain format restrictions, and that the rate of bypass must be constrained. In this report, we present an informal model of the ECA's critical requirements together with the assumptions under which the model was constructed. We then formalize this model by using the CSP Trace Model of computation. GRA

N93-23661# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.

SUPPORT MEASUREMENT AND ESTIMATING FOR ORACLE DATABASE APPLICATIONS USING MARK 2 FUNCTION POINTS M.S. Thesis

Steven D. Radnov Dec. 1992 150 p

(AD-A259686; AFIT/GSS/LSY/92D-4) Avail: CASI HC A07/MF A02

This study investigated the results of measuring software support of Oracle database applications and estimating the effort and schedule required to provide support. Software measurement was accomplished with a variant of the function points metric, called Mark 2 function points, which is comprised of three weighted parameters, inputs, entities, and outputs. A technique for mapping Mark H function points to Oracle DBMS components was developed, and the size of the software support for each project, per team, was measured by tabulating and weighting the number of inputs, entities, and outputs that are added, changed, and/or deleted. Software support effort was measured in work-hours and scheduled in calendar-weeks for given levels of function points. A data collection program was written to assist with tabulating the measurements and also provided an option for sizing the support by analogy. Observations were collected for 12 projects ranging up to 50 function points. The relationship between software support measurement in Mark 2 function points and the effort or schedule was extensively analyzed for one and two person teams. A relationship determined by regression analysis was shown to be statistically significant for both effort and schedule. GRA

N93-23666# Raytheon Co., Tewksbury, MA. Missile Systems Lab.

SOFTWARE DESIGN SPECIFICATION FOR THE MANUFACTURING OPTIMIZATION (MO) SYSTEM

Linda J. Lapointe, Thomas J. Laliberty, and Robert V. Bryant Dec. 1992 171 p

(Contract MDA903-92-C-0020; ARPA Order 8363)

(AD-A259707) Avail: CASI HC A08/MF A02

DICE has developed a concurrent engineering model that replicates the human tiger team concept. The basic tenet of the human tiger team is to have the various specialists contributing to the project co-located. In today's environment of complex product designs and geographically dispersed specialists, DIC envisioned a virtual tiger team working on a unified product model accessible by computer networks. Such an environment must enable specialists from each functional area to work on the design concurrently and share development ideas. GRA

N93-23730# Office of Research Analyses, Ottawa (Ontario).

INVESTIGATION OF PROOF TECHNIQUES WITHIN THE EVES VERIFICATION TECHNOLOGY Final Report

Sentot Kromodimoeljo and Bill Pase May 1992 76 p

(Contract DSS-W2207-0-AF09)

(DREO-FR-92-5451-02; CTN-93-60716) Copyright Avail: CASI HC A05/MF A01

Investigations were conducted on various approaches for enhancing the capabilities of the theorem prover NEVER and, hence, the overall effectiveness of the EVES software tool used for development of verified software. The research focused on improving the deductive capabilities of the theorem prover, such as by introducing new decision procedures. Specific issues studied included the following: the optimization of the rewrite rule, forward rule, and function invocation mechanisms in EVES, as well as improving the implementation of the deductive database; the feasibility of converting NEVER to use a clausal representation of formulae and also the feasibility of treating clause components as unordered; the feasibility of using the Knuth-Bendix procedure to develop decision procedures based on rewrite rules; the feasibility of generalizing the induction heuristics so that they apply to quantified formulae and/or formulae containing mutually recursive functions; improvements on the handling by EVES of typing predicates, based on experiments; and the applicability of parallelism to the implementation of NEVER, in particular, coarse grained parallelism and iterative deepening. CISTI

N93-23867# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.

PROTOCOL DESIGN AND IMPLEMENTATION USING FORMAL METHODS

Marten vanSinderen, Luis FerreiraPires, and Chris A. Vissers 1992 29 p Sponsored by Commission of European Communities

(Memo-INF-92-43; TIOS-92-19; ETN-93-93199) Copyright Avail: CASI HC A03/MF A01

A number of formal methods that support correct protocol design and implementation are reported. These methods are placed in the framework of a design methodology for distributed systems that was studied and developed within the ESPRIT (European Strategic Program for Research and Development in Information Technology) Lotosphere project. Design methods for synthesizing protocols by successive application of correctness preserving LOTOS transformations are addressed. This transformational approach is described and illustrated with a protocol design example. Some suggestions for relating design methods to milestones in the protocol design and implementation process are given in conclusion. ESA

N93-23959# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.

PLANNING MULTIPLE OBSERVATIONS FOR OBJECT RECOGNITION

Keith D. Gremban and Katsushi Ikeuchi 9 Dec. 1992 43 p

(Contract F33615-90-C-1465; ARPA Order 7597)

(AD-A259879; CMU-CS-92-146) Avail: CASI HC A03/MF A01

Most computer vision systems perform object recognition on the basis of the features extracted from a single image of the object. The problem with this approach is that it implicitly assumes that the available features are sufficient to determine the identity and pose of the object uniquely. If this assumption is not met, then the feature set is insufficient, and ambiguity results. Consequently, much research in computer vision has gone towards finding sets of features that are sufficient for specific tasks, with the result that each system has its own associated set of features. A single, general feature set would be desirable. However, research in automatic generation

of object recognition programs has demonstrated that pre-determined, fixed feature sets are often incapable of providing enough information to unambiguously determine object identity and pose. One approach to overcoming the inadequacy of any feature set is to utilize multiple sensor observations obtained from different viewpoints, and combine them with knowledge of the 3D structure of the object to perform unambiguous object recognition. Initial results towards performing object recognition using multiple observations to resolve ambiguities are presented. Starting from the premise that sensor motions should be planned out in advance, the difficulties involved in planning with ambiguous information are discussed. A representation for planning that combines geometric information with viewpoint uncertainty is presented. A sensor planner utilizing the representation was implemented, and the results of object recognition experiments performed with the planner are discussed. GRA

N93-23997# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.

SOAR-MODE v5.0 USER'S MANUAL FOR SOAR RELEASE 5.2 AND 6.0

Frank E. Ritter, Michael Hucka, and Thomas F. McGinnis 9 Dec. 1992 26 p Prepared in cooperation with Michigan Univ., Ann Arbor, Dept of Electrical Engineering and Computer Science and Carnegie Mellon Univ., Pittsburgh, PA

(Contract F33615-90-C-1465; ARPA Order 7597)

(AD-A259914; CMU-CS-92-205) Avail: CASI HC A03/MF A01

Soar-mode is a major within the GNU-Emacs editor. It provides an integrated, structured editor for editing, running, and debugging Soar models on the production level. Productions are treated as first class objects. With keystroke (or menu) commands productions can be directly loaded, examined, and queried about their current match status. Listings of the productions that have fired or are about to fire can be automatically displayed. Soar-mode includes and organizes, for the first time, complete on-line documentation on Soar and a simple browser to examine this information. GRA

N93-24019# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.

REPRESENTATION AND RECOGNITION OF FREE-FORM SURFACES

Herve Delingette, Martial Hebert, and Katsushi Ikeuchi Nov. 1992 43 p

(Contracts F33615-87-C-1499; DACA76-89-C-0014)

(AD-A259883; CMU-CS-92-214) Avail: CASI HC A03/MF A01

A new surface representation for recognizing curved objects is introduced. Our approach begins by representing an object by a discrete mesh of points built from range data or from a geometric model of the object. The mesh is computed from the data by deforming a standard shaped mesh, for example, an ellipsoid, until it fits the surface of the object. Local regularity constraints are defined that the mesh must satisfy. Then a canonical mapping between the mesh describing the object and a standard spherical mesh is defined. A surface curvature index that is pose-invariant is stored at every node of the mesh. This object representation is used for recognition by comparing the spherical model of a reference object with the model extracted from a new observed scene. It is shown how the similarity between reference model and observed data can be evaluated and it is shown how the pose of the reference object in the observed scene can be easily computed using this representation. Results are presented on real range images which show that this approach to modeling and recognizing three-dimensional objects has three main advantages: (1) it is applicable to complex curved surfaces that cannot be handled by conventional techniques; (2) it reduces the recognition problem to the computation of similarity between spherical distributions; in particular, the recognition algorithm does not require any combinatorial search; and (3) even though it is based on a spherical mapping, the approach can handle occlusions and partial views. GRA

N93-24063# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.

AN ONTOLOGY OF KNOWLEDGE GRAPHS

H. vandenBerg 13 Apr. 1992 19 p

(MEMO-1049; ETN-93-189) Avail: CASI HC A03/MF A01

Natural language understanding is described and modeled. A common view, namely that sentence meaning is equal to truth value, is rejected. Instead it is argued that someone's mind plays a major role in understanding language. A knowledge representation formalism called knowledge graphs is described that is suitable for the task of modeling natural language understanding. ESA

N93-24076# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.

PASCAL SUBROUTINES FOR STANDARD TEST PROBLEMS IN UNCONSTRAINED MINIMIZATION

K. M. Khoda and C. Storey Feb. 1992 29 p

(MATHS-Rept-A-155; ETN-93-93556) Avail: CASI HC A03/MF A01

A set of three PASCAL subroutines that can be used for testing unconstrained optimization software, based on 28 well known test functions with their corresponding analytical gradient veetors and standard starting points, is presented. The aim is to provide an optimized library routine for general purpose use to test the efficiency and reliability of unconstrained optimization software. ESA

N93-24125# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

AUTOMATED PROGRAM RECOGNITION BY GRAPH PARSING

Linda M. Wills Jul. 1992 337 p

(Contract N00014-88-K-0487)

(AD-A259609; AI-TR-1358) Avail: CASI HC A15/MF A03

The recognition of standard computational structures (cliches) in a program can help an experienced programmer understand the program. Based on the known relationships between the cliches, a hierarchical description of the program's design can be recovered. A graph parsing approach to automating program recognition in which programs are represented as attributed dataflow graphs is developed and studied and a library of cliches is encoded as an attributed graph grammar. Graph parsing is used to recognize cliche's in the code. It is demonstrated that this graph parsing approach is a feasible and useful way to automate program recognition. In studying this approach, two medium-sized, real-world simulator programs were experimented with. There are three aspects of the study. First, the representation's ability to suppress many common forms of program variation which hinder recognition is evaluated. Second, the expressiveness of the graph grammar formalism for capturing programming cliches is investigated. Third, the computational cost of our recognition approach with respect to the real-world simulator programs are empirically and analytically studied. GRA

N93-24223# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.

ACADEMIC LEGITIMACY OF THE SOFTWARE ENGINEERING DISCIPLINE Final Report

Daniel M. Berry Nov. 1992 71 p

(Contract F19628-90-C-0003)

(AD-A260241; CMU/SEI-92-TR-34; ESC-TR-92-034) Avail: CASI HC A04/MF A01

This report examines the academic substance of software engineering. It identifies the basic research questions and the methods used to solve them. What is learned during this research constitutes the body of knowledge of software engineering. The report then discusses, at length, what makes software production so difficult and makes software engineering so challenging an intellectual discipline. GRA

N93-24283# Naval Postgraduate School, Monterey, CA. Dept. of Computer Science.

A VERSION AND CONFIGURATION MODEL FOR SOFTWARE EVOLUTION Technical Report, May 1989 - Mar. 1990

Salah M. Badr Dec. 1992 26 p

(AD-A260557; NPS-CS-92-021) Avail: CASI HC A03/MF A01

This report introduces both a design database model and a version and configuration model for keeping track of all these overwhelming numbers of software system versions and keep track of which object version belongs to which system configuration in an automated manner transparent to the user. This gives the software development team the chance to concentrate on what is needed to be done to fix or improve system components instead of worrying about managing this enormous amount of data. This paper also shade some lights on our design management and job assignment system (DMJAS) that uses these two models to manage both design data and development team. GRA

N93-24315# Illinois Univ., Urbana. Coordinated Science Lab.
PROGRESSIVE RETRY FOR SOFTWARE ERROR RECOVERY IN DISTRIBUTED SYSTEMS
Yi-Min Wang, Yennun Huang, and W. K. Fuchs 1993 19 p
(Contract N00014-91-J-1283)
(AD-A260075) Avail: CASI HC A03/MF A01

In this paper, we describe a method of execution retry for bypassing software errors based on checkpointing, rollback, message reordering and replaying. We demonstrate how rollback techniques, previously developed for transient hardware failure recovery, can also be used to recover from software faults by exploiting message reordering to bypass software errors. Our approach intentionally increases the degree of nondeterminism and the scope of rollback when a previous retry fails. Examples from our experience with telecommunications software systems illustrate the benefits of the scheme. GRA

N93-24327# Allied-Signal Aerospace Co., Kansas City, MO. Kansas City Div.
INTEGRATED FLEXIBLE MANUFACTURING PROGRAM FOR MANUFACTURING AUTOMATION AND RAPID PROTOTYPING
S. L. Brooks, C. W. Brown, M. S. King, W. R. Simmons, and J. J. Zimmerman 1 Dec. 1992 9 p Presented at the National Aeronautics and Space Administration (NASA) Technology 2002 Conference, Baltimore, MD, 1-3 Dec. 1992
(Contract DE-AC04-76DP-00613)
(DE93-006722; KCP-613-5099; CONF-921230-3) Avail: CASI HC A02/MF A01

The Kansas City Division of Allied Signal Inc., as part of the Integrated Flexible Manufacturing Program (IFMP), is developing an integrated manufacturing environment. Several systems are being developed to produce standards and automation tools for specific activities within the manufacturing environment. The Advanced Manufacturing Development System (AMDS) is concentrating on information standards (STEP) and product data transfer; the Expert Cut Planner system (XCUT) is concentrating on machining operation process planning standards and automation capabilities; the Advanced Numerical Control system (ANC) is concentrating on NC data preparation standards and NC data generation tools; the Inspection Planning and Programming Expert system (IPPEX) is concentrating on inspection process planning, coordinate measuring machine (CMM) inspection standards and CMM part program generation tools; and the Intelligent Scheduling and Planning System (ISAPS) is concentrating on planning and scheduling tools for a flexible manufacturing system environment. All of these projects are working together to address information exchange, standardization, and information sharing to support rapid prototyping in a Flexible Manufacturing System (FMS) environment. DOE

N93-24407# California Univ., San Diego.
DESIGN AND PACKAGING OF FAULT TOLERANT OPTOELECTRONIC MULTIPROCESSOR COMPUTING SYSTEM Quarterly Progress Report, 15 Jan. - 14 Apr. 1992
Sing H. Lee 14 Apr. 1992 10 p
(Contract N00014-91-J-1988)
(AD-A260051) Avail: CASI HC A02/MF A01

During this quarter, we continued our research efforts on fabricating and testing packaged Correlation Matrix Tensor Multiplier module, developing a Computer Aided Design tool for solving PE placement problems in Oe-MCM's, and designing fault masking and reconfiguration of the twin butterfly interconnection network. GRA

N93-24469# Massachusetts Inst. of Tech., Cambridge.
THE ACTOR MODEL Final Report
Carl Hewitt 1993 7 p
(Contract N00014-88-K-0460)
(AD-A260196) Avail: CASI HC A02/MF A01

The objective of the Actor Model project is to contribute to the science of large scale concurrent systems and the technology which is enabled by this science. This work is based on the Actor Model, a universal paradigm for concurrent computation in which primitive computational entities (actors) communicate by passing messages. The inherent concurrency, reconfigurability, and asynchronous nature of the actor paradigm make it ideally suited for modeling and constructing sophisticated large scale concurrent systems on general purpose concurrent computers. This actor paradigm can also be used as a foundation for study and implementing other diverse concurrency paradigms. The Actor Model project involves study of the Actor model, implementation of a prototype Actor language (Acore), and study of large scale experimental actor systems. GRA

N93-24473*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
DEVELOPMENT OF CODE EVALUATION CRITERIA FOR ASSESSING PREDICTIVE CAPABILITY AND PERFORMANCE Final Report, Mar. 1991 - Mar. 1993
Shyi-Jang Lin, S. L. Barson, M. M. Sindir, and G. H. Prueger Mar. 1993 47 p
(Contract NAS8-38858)
(NASA-CR-192623; NAS 1.26:192623; RI/RD-93-124) Avail: CASI HC A03/MF A01

Computational Fluid Dynamics (CFD), because of its unique ability to predict complex three-dimensional flows, is being applied with increasing frequency in the aerospace industry. Currently, no consistent code validation procedure is applied within the industry. Such a procedure is needed to increase confidence in CFD and reduce risk in the use of these codes as a design and analysis tool. This final contract report defines classifications for three levels of code validation, directly relating the use of CFD codes to the engineering design cycle. Evaluation criteria by which codes are measured and classified are recommended and discussed. Criteria for selecting experimental data against which CFD results can be compared are outlined. A four phase CFD code validation procedure is described in detail. Finally, the code validation procedure is demonstrated through application of the REACT CFD code to a series of cases culminating in a code to data comparison on the Space Shuttle Main Engine High Pressure Fuel Turbopump Impeller. Author

N93-24476*# Arizona Univ., Tucson.
TELESCIENCE TESTBED PROGRAM: A STUDY OF SOFTWARE FOR SIRTF INSTRUMENT CONTROL Final Technical Report
Erick T. Young 30 Jun. 1992 25 p
(Grant NAG2-661)
(NASA-CR-192764; NAS 1.26:192764) Avail: CASI HC A03/MF A01

As a continued element in the Telescience Testbed Program (TTP), the University of Arizona Steward Observatory and the Electrical and Computer Engineering Department (ECE) jointly developed a testbed to evaluate the Operations and Science Instrument System (OASIS) software package for remote control of an instrument for the Space Infrared Telescope Facility (SIRTF). SIRTF is a cryogenically-cooled telescope with three focal plane instruments that will be the infrared element of NASA's Great Observatory series. The anticipated launch date for SIRTF is currently 2001. Because of the complexity of the SIRTF mission, it was not expected that the OASIS package would be suitable for instrument control in the flight situation, however, its possible use as a common interface during the early development and ground test phases of the project was considered. The OASIS package, developed at the University of Colorado for control of the Solar Mesosphere Explorer (SME) satellite, serves as an interface between the operator and the remote instrument which is connected via a network. OASIS provides a rudimentary windowing system as well as support for standard spacecraft communications protocols. The experiment performed all of the functions required of the MIPS simulation program. Remote control of the instrument was demonstrated but found to be inappropriate for SIRTF at this time for the following reasons: (1) programming interface is too difficult; (2) significant computer resources were required to run OASIS; (3) the communications interface is too complicated; (4) response time was slow; and (5) quicklook of image data was not possible. Author (revised)

N93-24539*# Old Dominion Univ., Norfolk, VA. Dept. of Chemistry and Biochemistry.
INSTRUMENTATION FOR HYPERSONIC AERODYNAMICS RESEARCH WITH TETHERED SATELLITES Final Report, 1 Jan. 1990 - 15 Jan. 1992 (Diskette Supplement)
Leonard T. Melfi, Jr. and Kenneth G. Brown, Jr. Jan. 1992 111 p
Diskette supplement: IBM compatible 5.25-inch DSHD
(Contract NAS1-18584; RTOP 967-30-30-01)
(NASA-CR-191435; NAS 1.26:191435; NONP-Suppl-DK-93-159784) Avail: Issuing Activity (Center for AeroSpace Information) HC/DK A13

Work on instrumentation for hypersonic aerodynamics research with tethered satellites with NASA LaRC began on 2 Jan. 1990, and extended through 31 Dec. 1991. The first year's effort concentrated on shuttle borne tether satellite systems, measurement requirements, instruments assessment, aerothermodynamic instrumentation definition, and tether technology. These aspects were studied in detail and are reported in a review article entitled 'Downward Deployed Tethered Satellite Systems, Measurement Techniques, and Instrumentation: A Review' by Kenneth G. Brown, Jr. et. al. The second year's effort concentrated on the development of compute codes to analyze instrument data from NASA's SEDS mission. This mission is planned to fly in early 1993 and consists of an instrumented end-mass deployed with a tether from an orbiting second stage of a Delta rocket. Additional data is recorded on the accompanying floppy disk.

Author (revised)

N93-24562# National Inst. of Standards and Technology, Gaithersburg, MD.

RASTER GRAPHICS: A TUTORIAL AND IMPLEMENTATION GUIDE

F. E. Spielman and L. H. Sharpe Jan. 1993 136 p

(PB93-145233; NISTIR-5108) Avail: CASI HC A07/MF A02

The report examines the technical issues facing an implement of the raster data interchange format defined in the Open Document Architecture (ODA) Raster Document Application Profile (DAP). The ODA Raster DAP is also included as an appendix to military specification MIL-R-28002B. Information previously scattered throughout several standards is incorporated into the report for ease of reference. The ODA Raster DAP is analyzed with regard to both notation and intent.

GRA

N93-24576# Xerox Palo Alto Research Center, CA.

EDITING IMAGES OF TEXT

S. C. Bagley and G. E. Kopec Nov. 1992 23 p

(PB93-149896; ISTL-92-3) Avail: CASI HC A03/MF A01

Image EMACS, a text editor for binary document images which illustrates an alternative to the format conversion paradigm are described. The goal of Image EMACS is to allow images to text to be created and manipulated as if they were conventional text files. The inputs and outputs of Image EMACS are simple interpretations of image elements, rather than a complete symbolic description of the image. Several applications of Image EMACS are presented including editing multilingual documents, reformatting text to a new column width, differential comparison of two versions of a document, and preprocessing an image prior to character recognition.

Author (revised)

N93-24582# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.

TP PROTOCOL FROM SPECIFICATION TO IMPLEMENTATION

Ing Widya, Gert-Jan vanderHeijden (Oce Nederland B.V., Venlo.), and Francois Juillot (SYSECA DSIT, Buc, France.) 1992 25 p Sponsored by Commission of European Communities

(Memo-INF-92-42; TIOS-92-18; ETN-93-93198) Copyright Avail: CASI HC A03/MF A01

An exercise concerned with the specification and implementation design of a realistic OSI (Open System Interconnection) application layer protocol in accordance with the LotoSphere methodology is presented. Some of the experiences acquired during the design process are reported. The main motivation of the work presented is the need to have a engine assessment of the design methodology for its industrial applicability. The OSI Transaction Processing (TP) protocol is selected as a design example due to its distributed nature and its entangled compositional structure. The OSI TP structure is comprised of the following: OSI common; application service elements AD-SE (Association Control Service Element) and CCR-SE (Commitment, Concurrency and recovery SE); and TP specific elements. The design trajectory of the TP specific parts is discussed. The design process starts with a nonformalized protocol description and after several design steps ends with an implementation specified in LOTOS. This process is globally constrained by realizability and open endedness requirements. The derived implementation is expressed in a state (machine) oriented way and is, in a design sense, close to a realization. UNIX workstations with a running ISODE (Internationapl Standards Organization Development Environment) are selected as the realization environment. An alternative design approach which suitably fits ISODE is exposed but not elaborated. A second design cycle is undertaken to enable some evaluation in the open endedness of the specification.

ESA

N93-24587# Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.

AUTOMOUSE: AN IMPROVEMENT TO THE MOUSE COMPUTERIZED UNCERTAINTY ANALYSIS SYSTEM OPERATIONAL MANUAL

Albert J. Klee Aug. 1992 210 p

(PB93-100113; EPA/600/R-92/145; EPA/SW/DK-92/053A) Avail: CASI HC A10/MF A03

Under a mandate of national environmental laws, the agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. The Risk Reduction Engineering Laboratory is responsible for planning, implementing, and managing research development, and demonstration programs to provide an authoritative, defensible engineering basis in support of the policies, programs, and regulations of the EPA with respect to drinking water, wastewater, pesticides, toxic substances, solid and hazardous wastes, and Superfund-related activities. The publication is one of the products of that research and provides a vital communication link between the researcher and the user community. The manual describes a system, called MOUSE (for Modular Oriented Uncertainty SystEm), for dealing with the computational problems of uncertainty, specifically in models that consist of a set of one or more equations. Since such models are frequently encountered in the fields of environmental science, risk analysis, economics, and engineering, the system has broad application throughout these fields. An important part of the MOUSE system is AutoMOUSE which actually writes the computer programs required for the uncertainty analysis computations. Thus, no prior programming knowledge is needed to learn or use MOUSE and, because of its transportability and compactness, the system can be run on a wide variety of personal computers available to the U.S. Environmental Protection Agency and/or its contractors and grantees.

GRA

N93-24604*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.

PERFORMANCE AND STATE-SPACE ANALYSES OF SYSTEMS USING PETRI NETS

James Francis Watson, III Nov. 1992 191 p

(Grant NAGw-1333)

(NASA-CR-193195; NAS 1.26:193195; RPI-CIRSSE-129) Copyright Avail: CASI HC A09/MF A02

The goal of any modeling methodology is to develop a mathematical description of a system that is accurate in its representation and also permits analysis of structural and/or performance properties. Inherently, trade-offs exist between the level detail in the model and the ease with which analysis can be performed. Petri nets (PN's), a highly graphical modeling methodology for Discrete Event Dynamic Systems, permit representation of shared resources, finite capacities, conflict, synchronization, concurrency, and timing between state changes. By restricting the state transition time delays to the family of exponential density functions, Markov chain analysis of performance problems is possible. One major drawback of PN's is the tendency for the state-space to grow rapidly (exponential complexity) compared to increases in the PN constructs. It is the state space, or the Markov chain obtained from it, that is needed in the solution of many problems. The theory of state-space size estimation for PN's is introduced. The problem of state-space size estimation is defined, its complexities are examined, and estimation algorithms are developed. Both top-down and bottom-up approaches are pursued, and the advantages and disadvantages of each are described. Additionally, the author's research in non-exponential transition modeling for PN's is discussed. An algorithm for approximating non-exponential transitions is developed. Since only basic PN constructs are used in the approximation, theory already developed for PN's remains applicable. Comparison to results from entropy theory show the transition performance is close to the theoretic optimum. Inclusion of non-exponential transition approximations improves performance results at the expense of increased state-space size. The state-space size estimation theory provides insight and algorithms for evaluating this trade-off.

Author (revised)

N93-24607 Waterloo Univ. (Ontario).
PROCESS AND EVENT ABSTRACTION FOR DEBUGGING DISTRIBUTED PROGRAMS Ph.D. Thesis
Wing Hong Cheung Waterloo, Ontario Univ. of Waterloo 1989 226 p
(ISBN-0-315-51884-7; CTN-93-60643) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, J8X 3X2, Canada, HC

A rigorous basis is presented for the development of abstraction facilities in a distributed debugger. A distributed program is modelled as a cluster of cooperating processes, communicating with each other via messages. The program behavior is described as a sequence of partially ordered events generated by those processes. The event ordering is defined by a precedence relation and is recorded with partially ordered logical clocks. Abstraction is defined as an operation to condense a subgraph of components into a single component. Abstraction is applied to the program behavior in two dimensions: process structure and event sequence. Preservation of event precedences in both process and event abstraction is demonstrated along with the correct maintenance of observed primitive events and their precedences. Based on this result, guidelines and algorithms are developed to construct abstraction facilities in a distributed debugger. Three mechanisms for event recording, replay, and timestamp construction are also developed to capture precedence and additional information of primitive events. The development permits the debugger designer to trade runtime overhead against debugging time processing. Author (CISTI)

N93-24608 Alberta Univ., Edmonton. Dept. of Electrical Engineering.
A PARAMETER-CONTROLLED RELAXATION ALGORITHM FOR BAYESIAN RESTORATION OF IMAGES USING THE MAXIMUM ENTROPY METHOD (DESIGN, ANALYSIS, MACH BAND SIMULATION AND PARALLELIZATION) Ph.D. Thesis
Kalpagam Krishnan Edmonton, Alberta Univ. of Alberta 1990 236 p
(ISBN-0-315-64776-0; CTN-93-60645) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, J8X 3X2, Canada, HC

A relaxation scheme is developed for the maximum entropy (ME) method and applied to the Bayesian restoration of images. The scheme involves optimizing a system by controlling its states in sequence, using specific parameter strategies. The results evolve directly from the functional analysis of a stationary point equation derived from the Bayesian based entropy optimization functional. The convergence behavior of the system is characterized in terms of its state entropy. Given a degraded input image and the degradation parameter(s), the relaxation scheme performs restoration using a numerical algorithm. For inputs degraded by Gaussian noise, specification of noise variance is not necessary. The algorithm estimates the control parameters adaptively to minimize the influence of the strength of the external constraints upon the system, and also allows the user to specify a parameter to control the speed of convergence. Test studies demonstrate an expected behavior of the algorithm. New prospects for the ME method are shown in edge detection and enhancement. Parallelization of the restoration algorithm is attempted, with initial implementation studies conducted on Myrias computers. Performance studies show optimum efficiencies of 91 percent with 16 processors for the convolution algorithm and 78.4 percent with 8 processors for the ME deconvolution algorithm using the relaxation scheme. Author (CISTI)

N93-24624 Windsor Univ. (Ontario). Dept. of Electrical Engineering.
SHAPE-CONTOUR RECOGNITION USING MOMENT INVARIANTS Ph.D. Thesis
Saeid Omar Belkasim Windsor, Ontario Univ. of Windsor 1990 172 p
(ISBN-0-315-61036-0; CTN-93-60659) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

A comparative evaluation of the effectiveness of moment invariants as shape sensitive features for pattern recognition applications is presented. Zernike, pseudo Zernike, Hu, Bamieh, and regular moment invariants were compared for their performance in a shape recognition study using two data sets: handwritten numerals and pictures of military aircraft under various war loads. Zernike moment invariants (ZMI) and pseudo Zernike moment invariants (PZMI) have been derived in a new form for the nth order. New normalization procedures aimed at minimizing the effect of information redundancy as well as reducing the dynamic range have been proposed for both ZMI and PZMI. Techniques for reducing the feature vector size have also been proposed to improve the efficiency of both ZMI and PZMI. Using the new normalization scheme, it is shown that Zernike moment invariants as derived in this form yield a better performance. New algorithms have also been developed for the optimum thresholding and contour extraction of images. Author (CISTI)

N93-24642# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
A USER'S MANUAL FOR SOFTWARE GPR92
K. M. Khoda and C. Storey Sep. 1992 22 p
(MATHS-REPT-A-175; ETN-93-93559) Avail: CASI HC A03/MF A01

GPR92 is an optimized software routine for the various implementations of the Generalized Polak-Ribiere (GPR) algorithm for nonlinear optimization. The algorithm is based on the effects of inexact line searches on conjugate gradient methods. A description of GPR92 which should help the user to gain sufficient insight into the routine to create and execute a driver program to implement it is presented. GPR92 is designed to minimize an unconstrained nonlinear function of several variables whether the first partial derivatives are known analytically or not. The user must provide the subroutine that defines the objective function and/or its first partial derivatives if available. The derivatives are approximated numerically when they are not known analytically. GPR92 is best used on problems having smooth, that is, at least twice continuously differentiable objective functions, without any constraints in the variables. Because of its modest storage requirements it could be useful on large scale problems for which computer storage is a limiting factor. ESA

N93-24655*# San Jose State Univ., CA. Aerospace Engineering.
FLOWFIELD COMPUTER GRAPHICS Final Annual Technical Report, 1 Oct. 1991 - 31 Jan. 1993
Richard Desautel 10 May 1993 152 p Original contains color illustrations
(Contract NCC2-430)
(NASA-CR-193029; NAS 1.26:193029) Avail: CASI HC A08/MF A02; 2 functional color pages

The objectives of this research include supporting the Aerothermodynamics Branch's research by developing graphical visualization tools for both the branch's adaptive grid code and flow field ray tracing code. The completed research for the reporting period includes development of a graphical user interface (GUI) and its implementation into the NAS Flowfield Analysis Software Tool kit (FAST), for both the adaptive grid code (SAGE) and the flow field ray tracing code (CISS).
Derived from text

N93-22022# Computing Devices Co., Ottawa (Ontario). Ground Systems Div.
MULTI-WINDOW REGISTRATION ALGORITHM FOR AUTOMATIC DETECTION AND TRACKING OF MOVING TARGETS
P. Church and T. Gajdicar *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 7 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A02/MF A02

N93-22150*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TRANSPORTABLE APPLICATIONS ENVIRONMENT (TAE) PLUS: A NASA TOOL FOR BUILDING AND MANAGING GRAPHICAL USER INTERFACES
Martha R. Szczur *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 3-12 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22151*# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.
ADVANCED DISPLAY OBJECT SELECTION METHODS FOR ENHANCING USER-COMPUTER PRODUCTIVITY
Glenn A. Osga *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb.

1993 p 13-17 Sponsored in part by Office of Naval Technology (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

N93-22157*# Lockheed Engineering and Sciences Co., Bay Saint Louis, MS. Advanced Sensor Development Lab.
AN INVESTIGATIVE STUDY OF MULTISPECTRAL DATA COMPRESSION FOR REMOTELY-SENSED IMAGES USING VECTOR QUANTIZATION AND DIFFERENCE-MAPPED SHIFT-CODING
S. Jaggi *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 73-88 (For primary document see N93-22149 08-99)
(Contract NAS13-315)
Avail: CASI HC A03/MF A04

N93-22168*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AUTOMATED REAL-TIME SOFTWARE DEVELOPMENT
Denise R. Jones, Carrie K. Walker, and John J. Turkovich (Draper, Charles Stark Lab., Inc., Cambridge, MA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 183-193 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

N93-22169*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONSTRAINT CHECKING DURING ERROR RECOVERY
Robyn R. Lutz and Johnny S. K. Wong (Iowa State Univ. of Science and Technology, Ames.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 194-203 (For primary document see N93-22149 08-99)
(Grant NGT-50269)
Avail: CASI HC A02/MF A04

N93-22264*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RESULTS OF PROTOTYPE SOFTWARE DEVELOPMENT FOR AUTOMATION OF SHUTTLE PROXIMITY OPERATIONS Abstract Only
Harry K. Hiers and Oscar W. Olszewski (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22279*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NEW DEVELOPMENTS IN ASTRODYNAMICS ALGORITHMS FOR AUTONOMOUS RENDEZVOUS Abstract Only
Allan R. Klumpp *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 4 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-23930# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
THE ROSAT STANDARD ANALYSIS SOFTWARE SYSTEM
Wolfgang Voges, Rainer Gruber, Joachim Paul, Klaus Bickert, Achim Bohnet, Jirina Bursik, Konrad Dennerl, Jakob Englhauser, Gisela Hartner, and Winfried Jennert et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 223-224 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; EAS, EPD, ESTEC, Noordwijk, Netherlands, HC

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N93-22060# Argonne National Lab., IL.
CONTACT-IMPACT SIMULATIONS ON MASSIVELY PARALLEL SIMD SUPERCOMPUTERS
E. J. Plaskacz, T. Belytscko, and H. Y. Chiang (Northwestern Univ., Evanston, IL.) 1992 29 p Presented at the Symposium for High-Performance Computing for Flight Vehicles, Washington, DC, 7-9 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-004188; ANL/CP-76686; CONF-921210-3) Avail: CASI HC A03/MF A01

The implementation of explicit finite element methods with contact-impact on massively parallel SIMD computers is described. The basic parallel finite element algorithm employs an exchange process which minimizes interprocessor communication at the expense of redundant computations and storage. The contact-impact algorithm is based on the pinball method in which compatibility is enforced by preventing interpenetration on spheres embedded in elements adjacent to surfaces. The enhancements to the pinball algorithm include a parallel assembled surface normal algorithm and a parallel detection of interpenetrating pairs. Some timings with and without contact-impact are given. DOE

N93-22388# California Univ., Berkeley. Lawrence Berkeley Lab.
EXPERIENCE WITH THE UNITREE MASS STORAGE SYSTEM
H. H. Holmes and S. Loken Sep. 1992 4 p Presented at the 10th Conference on Computing in High Energy Physics, Annecy, France, 21-25 Sep. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004717; LBL-32863; CONF-920966-20) Avail: CASI HC A01/MF A01

Lawrence Berkeley Laboratory (LBL) is a beta test site for the UniTree mass storage system. Our initial configuration is based on a Sun workstation and includes 10 gigabytes (GB) of magnetic disk cache, 700 GB of Exabyte 8 mm tape storage, with two tape robots. We support a user community of 15 to 20 active users, about 250,000 files, and 33 GB of user data. The largest file stored is 1.5 GB. As of May 1992, we consider the system to be adequately stable and reliable for production use. As a beta site, we have worked on the Sun port, on the tape drivers for SunOS, and on integrating our tape robots into the UniTree software. File retrieval from tape usually takes less than five minutes. Continuing concerns are tape longevity and reliability, and improving performance to support 100 Mb FDDI. DOE

N93-22434# Los Alamos National Lab., NM.
DATA-PARALLEL LANGEVIN DYNAMICS SIMULATIONS
P. S. Lomdahl Nov. 1992 9 p Presented at the Center for Nonlinear Studies Conference: Nonlinearity in Materials Science, Los Alamos, NM, May 1992
(Contract W-7405-eng-36)
(DE93-003836; LA-UR-92-3783; CONF-9205229-2) Avail: CASI HC A02/MF A01

The basic principles of data-parallel programming on massively parallel computers is outlined and illustrated with examples from Langevin dynamics simulations of surface growth in the presence of dislocation defects. DOE

N93-22474# Edgewater Computer Systems, Inc., Carp (Ontario).
INVESTIGATION OF THE POSSIBILITY OF SUCCESS OF THE FUTUREBUS+ AS A MILITARY AND COMMERCIAL STANDARD IN THE CURRENT CONTEXT, REVISION A
Duane L. Anderson 28 Oct. 1991 80 p
(CTN-93-60712) Copyright Avail: CASI HC A05/MF A01

A review is presented of the performance of new and future high performance microprocessors, military and commercial computing requirements, and the possible reaction of consumers of computer technology to Futurebus+. An in-depth review of multiprocessor interconnects is then made, considering features, market, enhancements, and issues important in satisfying military requirements. The review of leading established backplane busses includes the VMEbus, Multibus 2, EISA, Micro Channel, and NuBus. It is shown that most if not all of the

techniques and features used on the Futurebus+ can be applied to the established busses. A review of possible new bus standards reveals a possibly significant new bus standard, Dynabus, that has a level of performance somewhat greater than that of Futurebus+, and functionality similar to that of the Futurebus+. A review of ring networks, switched networks, and point to point networks suggests that sometimes such structures can provide superior price and performance characteristics to Futurebus+. It is concluded that the Futurebus+ has insufficient performance to satisfy needs of current and future high performance microprocessors, and should not be counted on to become a widely used commercial standard. Author (CISTI)

N93-22512# Oak Ridge National Lab., TN.
PARTITIONING A CHORDAL GRAPH INTO TRANSITIVE SUBGRAPHS FOR PARALLEL SPARSE TRIANGULAR SOLUTION
B. W. Peyton, A. Pothen (Waterloo Univ., Ontario.), and Xiaoqing Yuan (IBM Canada Lab., North York, Ontario.) Dec. 1992 33 p
(Contracts DE-AC05-84OR-21400; DE-FG02-91ER-25095)
(DE93-006614; ORNL/TM-12270) Avail: CASI HC A03/MF A01

A recent approach for solving sparse triangular systems of equations on massively parallel computers employs a factorization of the triangular coefficient matrix to obtain a representation of its inverse in product form. The number of general communication steps required by this approach is proportional to the number of factors in the factorization. The triangular matrix can be symmetrically permuted to minimize the number of factors over suitable classes of permutations, and thereby the complexity of the parallel algorithm can be minimized. Algorithms for minimizing the number of factors over several classes of permutations have been considered in earlier work. Let F = L + L(exp T) denote the symmetric filled matrix corresponding to a Cholesky factor L, and let G(sub F) denote the adjacency graph of F. In this paper we consider the problem of minimizing the number of factors over all permutations which preserve the structure of G(sub F). The graph model of this problem is to partition the vertices G(sub F) into the fewest transitively closed subgraphs over all perfect elimination orderings while satisfying a certain precedence relationship. The solution to this chordal graph partitioning problem can be described by a greedy scheme which eliminates a largest permissible subgraph at each step. Further, the subgraph eliminated at each step can be characterized in terms of lengths of chordless paths in the current elimination graph. This solution relies on several results concerning transitive perfect elimination orderings introduced in this paper. We describe a partitioning algorithm with (Omicron)(absolute value of V + absolute value of E) time and space complexity. DOE

N93-22531# Lawrence Livermore National Lab., CA.
EVALUATION OF DISTRIBUTED COMPUTING TOOLS
L. Stanberry 28 Oct. 1992 5 p
(Contract W-7405-eng-48)
(DE93-007408; UCRL-ID-112221) Avail: CASI HC A01/MF A01

The original goal stated in the collaboration agreement from LCC's perspective was 'to show that networking tools available in UNICOS perform well enough to meet the requirements of LCC customers'. This translated into evaluating how easy it was to port ELROS over CRI's ISO 2.0, which itself is a port of ISODE to the Cray. In addition we tested the interoperability of ELROS and ISO 2.0 programs running on the Cray, and communicating with each other, and with servers or clients running on other machines. To achieve these goals from LCC's side, we ported ELROS to the Cray, and also obtained and installed a copy of the ISO 2.0 distribution from CRI. CRI's goal for the collaboration was to evaluate the usability of ELROS. In particular, we were interested in their potential feedback on the use of ELROS in implementing ISO protocols--whether ELROS would be easter to use and perform better than other tools that form part of the standard ISODE system. To help achieve these goals for CRI, we provided them with a distribution tar file containing the ELROS system, once we had completed our port of ELROS to the Cray. DOE

N93-22545# Sandia National Labs., Albuquerque, NM.
PARALLEL PROCESSOR FOR REAL-TIME STRUCTURAL CONTROL
B. L. Tise 1992 9 p Presented at the Conference on Smart Structures and Materials, Albuquerque, NM, 1-4 Feb. 1993
(Contract DE-AC04-76DP-00789)
(DE93-006284; SAND-92-2918C; CONF-930220-1) Avail: CASI HC A02/MF A01

A parallel processor that is optimized for real-time linear control has been developed. This modular system consists of A/D modules, D/A modules, and floating-point processor modules. The scalable processor uses up to 1,000 Motorola DSP96002 floating-point processors for a peak computational rate of 60 GFLOPS. Sampling rates up to 625 kHz are supported by this analog-in to analog-out controller. The high processing rate and parallel architecture make this processor suitable for computing state-space equations and other multiply/accumulate-intensive digital filters. Processor features include 14-bit conversion devices, low input-output latency, 240 Mbyte/s synchronous backplane bus, low-skew clock distribution circuit, VME connection to host computer, parallelizing code generator, and look-up-tables for actuator linearization. This processor was designed primarily for experiments in structural control. The A/D modules sample sensors mounted on the structure and the floating-point processor modules compute the outputs using the programmed control equations. The outputs are sent through the D/A module to the power amps used to drive the structure's actuators. The host computer is a Sun workstation. An Open Windows-based control panel is provided to facilitate data transfer to and from the processor, as well as to control the operating mode of the processor. A diagnostic mode is provided to allow stimulation of the structure and acquisition of the structural response via sensor inputs. DOE

N93-22676# Ecole Centrale de Lyon (France).
STUDY AND DEVELOPMENT OF A MULTIPROCESSOR INTERFACE CIRCUIT (THESIS ANNEX), VOLUME 2 Ph.D. Thesis [ETUDE ET REALISATION D'UN CIRCUIT D'INTERFACE DANS UN ENVIRONNEMENT (ANNEXE DE LA THESE)]
Jean-Michel Courbet 1991 45 p In FRENCH
(ECL-91-11-Vol-2; ETN-93-91951) Avail: CASI HC A03/MF A01

An annex to a study and development of a PSB (Parallel System Bus) for the Multibus 2 system is presented. Generalities of ASIC's (Application Specific Integrated Circuits) and a description of PLD's (Programmable Logic Devices) are presented. Test techniques (internal scan, boundary scan, BIST, and BILBO) are described and application boards are illustrated. ESA

N93-22755# Sandia National Labs., Albuquerque, NM.
NETWORK STORAGE SERVICE USAGE CHARACTERISTICS
R. A. Haynes 1992 7 p Presented at the 12th IEEE Symposium on Mass Storage Systems, Monterey, CA, 25 Apr. 1993
(Contract DE-AC04-76DP-00789)
(DE93-003998; SAND-92-2418C; CONF-930461-1) Avail: CASI HC A02/MF A01

Performance and functionality increases in network environments have increased the need for readily accessible mass storage. UNIX-based networks and mass storage systems are providing the required connectivity and interoperability, however, how UNIX-based mass storage systems are being used is not well documented. A study of the usage of the UNIX-based Network Storage Service at Sandia National Laboratories is discussed. DOE

N93-22763# California Univ., Berkeley. Lawrence Berkeley Lab.
AN ELECTRONIC STROLL THROUGH THE GLOBAL VILLAGE
J. Chew Sep. 1992 9 p Presented at the IEEE International Professional Communications Conference: Crossing Frontiers, Santa Fe, NM, 30 Sep. 1992
(Contract DE-AC03-76SF-00098)
(DE93-005962; LBL-32934; CONF-9209142-10) Avail: CASI HC A02/MF A01

This paper is a semi-random walk through Usenet News, a bulletin board system that exists on the vast Internet computer network. Interaction in such a medium is an interesting hybrid of speech and writing, of monologue and dialogue, and sometimes an open shouting match in a crowded room. Those who are intrigued by these matters will be able to see a number of research areas exposed in this frankly anecdotal paper. In addition to being anecdotal, this paper is a work of participatory observation. In fact, I occasionally let it be known that I was observing the sociology and rhetoric of the newsgroups. The natives appeared unimpressed. DOE

N93-22828*# Louisville Univ., KY. Dept. of Microbiology and Immunology.

CYTOKINES AND IMMUNE SURVEILLANCE IN HUMANS Semiannual Progress Report No. 5, Oct. 1992 - Mar. 1993

Gerald Sonnenfeld Mar. 1993 30 p

(Grant NAG9-485)

(NASA-CR-192728; NAS 1.26:192728) Avail: CASI HC A03/MF A01

Evidence from both human and rodent studies has indicated that alterations in immunological parameters occur after space flight. Among the parameters shown, by us and others, to be affected is the production of interferons. Interferons are a family of cytokines that are antiviral and play a major role in regulating immune responses that control resistance to infection. Alterations in interferon and other cytokine production and activity could result in changes in immunity and a possible compromise of host defenses against both opportunistic and external infections. The purpose of the present study is to further explore the effects of space flight on cytokines and cytokine-directed immunological function. Author

N93-22868# Lawrence Livermore National Lab., CA.

PMC: A SHARED SHORT-CUT TO PORTABLE PARALLEL POWER

J. A. Rathkopf 16 Nov. 1992 7 p Presented at the 1992 Nuclear Explosives Code Developers Conference, Sunnyvale, CA, 2-6 Nov. 1992

(Contract W-7405-eng-48)

(DE93-005815; UCRL-JC-112311; CONF-9211128-6) Avail: CASI HC A02/MF A01

Monte Carlo particle transport has been shown to be very well suited to exploit the dramatic speedups available from Multiple Parallel Processors (MPP's). Other portions of large-scale codes that simultaneously simulate a variety of physical processors are less easily adapted to MPPS. PMC (Parallel Monte Carlo) is a package of generic interface routines that allow distributed processing where Monte Carlo is performed on an MPP while the other physics is simulated on a conventional, serial supercomputer. PMC handles passing of messages between the serial machine and the MPP, passing of messages between nodes on the MPP, distributing work between nodes, and providing independent, reproducible sequences of random numbers. Reproducibility is ensured through multi-tasking on nodes. As long as the number of tasks remains constant from one problem execution to another, the Monte Carlo simulation will yield identical results regardless of the number of nodes used. A task is a portion of work such as advancing a collection of particles from the beginning of a time step to its end. PMC handles this multi-tasking. PMC has been designed to allow re-use of existing Monte Carlo transport packages with minimal rewrite. DOE

N93-22933# Jarvis Christian Coll., Hawkins, TX.

LARGE SCALE CONTROL AND DISTRIBUTED COMPUTING SYSTEMS UNDER STOCHASTIC STRUCTURAL PERTURBATIONS Final Report, 15 Aug. 1990 - 14 Aug. 1992

S. Sathananthan and G. S. Ladde 28 Jan. 1993 3 p

(Contract DAAL03-90-G-0180)

(AD-A260501; ARO-28145.9-MA-SAH) Avail: CASI HC A01/MF A01

The research was directed to initiate a study of large-scale hereditary/non-hereditary control and distributed systems under randomly varying structural perturbations. Three principal areas of research, namely, (1) stability, convergence, etc., (2) error lotimation between the stochastic and corresponding deterministic systems, (3) applications from various disciplines are investigated. GRA

N93-22937# Los Alamos National Lab., NM.

EFFICIENTLY MODELING NEURAL NETWORKS ON MASSIVELY PARALLEL COMPUTERS

R. M. Farber 1992 11 p Presented at the NASA Conference, Houston, TX, 1-3 Jun. 1992

(Contract W-7405-eng-36)

(DE93-003787; LA-UR-92-3568; CONF-9206318-1) Avail: CASI HC A03/MF A01

Neural networks are a very useful tool for analyzing and modeling complex real world systems. Applying neural network simulations to real world problems generally involves large amounts of data and massive amounts of computation. To efficiently handle the computational requirements of large problems, a highly efficient neural network compiler for serial computers, vector computers, vector parallel computers, and fine grain SIMD computers such as the CM-2 connection machine was implemented. The mapping used by the compiler to implement feed-forward backpropagation neural networks for a SIMD architecture parallel computer is described. Thinking Machines Corporation has benchmarked our code at 1.3 billion interconnects per second (approximately 3 gigaflops) on a 64,000 processor CM-2 connection machine (Singer 1990). This mapping is applicable to other SIMD computers and can be implemented on computers such as the CM-5 connection machine. Our mapping has virtually no communications overhead with the exception of the communications required for a global summation across the processors. Very large neural networks which have many neurons and interconnects can be modeled efficiently and the mapping can be extended to arbitrarily large networks by merging the memory space of separate processors with fast adjacent processor inter-processor communications. The simulation of only feed forward neural network is considered although this method is extendible to recurrent networks. DOE

N93-22996# Oak Ridge National Lab., TN.

AUTOMATIC CODE GENERATION FOR DISTRIBUTED ROBOTIC SYSTEMS

J. P. Jones 1993 8 p Presented at the 5th Topical Meeting on Robotics and Remote Systems, Knoxville, TN, 26-29 Apr. 1993

(Contract DE-AC05-84OR-21400)

(DE93-005779; CONF-930403-11) Avail: CASI HC A02/MF A01

Hetero Helix is a software environment which supports relatively large robotic system development projects. The environment supports a heterogeneous set of message-passing LAN-connected common-bus multiprocessors, but the programming model seen by software developers is a simple shared memory. The conceptual simplicity of shared memory makes it an extremely attractive programming model, especially in large projects where coordinating a large number of people can itself become a significant source of complexity. We present results from three system development efforts conducted at Oak Ridge National Laboratory over the past several years. Each of these efforts used automatic software generation to create 10 to 20 percent of the system. DOE

N93-23026# Brookhaven National Lab., Upton, NY.

THE QCD TERAFLOPS PROJECT

S. Gottlieb 1992 4 p Presented at the Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL, 10-14 Nov. 1992

(Contract DE-AC02-76CH-00016)

(DE93-006386; BNL-48253; CONF-921122-27) Avail: CASI HC A01/MF A01

Increased computer power is essential for future progress in lattice gauge theory and for other Grand challenge applications. We address the physics that can be done with a computer capable of sustaining 1 Teraflops for QCD and the technology that will make it possible to construct such a computer within the next three years. Our collaboration has proposed to build a computer based on the Thinking Machines CM5 communication network, but with nodes 10 times faster. DOE

N93-23204# Science Applications International Corp., San Diego, CA. Foreign Applied Sciences Assessment Center.

PARALLEL PROCESSING RESEARCH IN THE FORMER SOVIET UNION Technical Assessment Report

J. J. Dongarra, L. Snyder, and P. Wolcott Mar. 1992 145 p

(PB93-134435) Avail: CASI HC A07/MF A02

The technical assessment report examines strengths and weaknesses of parallel processing research and development in the Soviet Union during the 1980's (through the first half of 1991). The assessment was carried out by a panel of US scientists who are experts on parallel processing hardware, software, algorithms, and applications, and on Soviet computing. GRA

N93-23245# Los Alamos National Lab., NM.

IMPLEMENTATION OF A MONTE CARLO ALGORITHM FOR NEUTRON TRANSPORT ON A MASSIVELY PARALLEL SIMD MACHINE

R. S. Baker 1992 9 p Presented at the International Topical Meeting on Mathematical Methods and Supercomputing in Nuclear Application, Karlsruhe, Germany, 19-23 Apr. 1993

(Contract W-7405-eng-36)
(DE93-005461; LA-UR-92-4364; CONF-930404-2) Avail: CASI HC A02/MF A01

We present some results from the recent adaptation of a vectorized Monte Carlo algorithm to a massively parallel architecture. The performance of the algorithm on a single processor Cray Y-MP and a Thinking Machine Corporations CM-2 and CM-200 is compared for several test problems. The results show that significant speedups are obtainable for vectorized Monte Carlo algorithms on massively parallel machines, even when the algorithms are applied to realistic problems which require extensive variance reduction. However, the architecture of the Connection Machine does place some limitations on the regime in which the Monte Carlo algorithm may be expected to perform well. DOE

N93-23357# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
LOTOS SPECIFICATION STYLE FOR OSI
K. J. Turner (Stirling Univ., Scotland.) and M. vanSinderen 23 Jun. 1992 26 p
(Memo-INF-92-46; TIOS-92-21; ETN-93-9302) Copyright Avail: CASI HC A03/MF A01

The architecture of Open Systems Interconnection (OSI) is used to derive guidelines for writing LOTOS specifications of distributed systems. In particular, the architectural concepts that underlie service and protocol designs are examined in detail. For each of these concepts a representation in LOTOS is given. Examples are provided of how the LOTOS representations of the concepts are used in the construction of LOTOS specifications of service and protocol designs. The approach described is motivated by the need for producing distributed system specifications in a more consistent and productive fashion. ESA

N93-23453# Stanford Univ., CA.
ASYNCHRONOUS DESIGN FOR PARALLEL PROCESSING ARCHITECTURES Semiannual Report, Jul. - Dec. 1992
Teresa Y. Meng Dec. 1992 3 p
(Contract N00014-89-J-3036)
(AD-A259776) Avail: CASI HC A01/MF A01

A design methodology for connecting heterogeneous hardware modules that have inherently different functional and timing behavior is discussed. With the constraints dictated by the system-level interaction, a modular design approach without compromising the global performance needs to be adopted. The main task of this effort will be the development of the theory for optimal interface circuit synthesis from a high-level specification, with emphasis on testability and performance. GRA

N93-23641# Massachusetts Univ., Amherst.
DESIGN AND ANALYSIS OF SCHEDULING POLICIES FOR REAL-TIME COMPUTER SYSTEMS Final Report
J. F. Kurose, C. M. Krishna, and D. Towsley 1992 19 p
(Contract N00014-87-K-0796)
(AD-A259806) Avail: CASI HC A03/MF A01

Our research funded under ONR contract N00014-87-K-0796 can be broadly divided into five areas: (1) design and analysis of deadline based scheduling policies, (2) design and evaluation of high performance and fault tolerant disk architectures for real-time systems, (3) design and evaluation of scheduling policies for real-time tasks with incremental-value-with-increased-execution-time characteristics, (4) reliability and testing of real-time systems, and (5) scheduling for real-time parallel processing systems. These topics will be the subject of the remainder of the technical section. Additional details of our work can be found in the cited technical papers and reports. GRA

N93-23653# Syracuse Univ., NY.
NORTHEAST PARALLEL ARCHITECTURES CENTER (NPAC) Final Report, Jan. 1989 - Sep. 1991
Geoffrey Fox Jul. 1992 236 p
(Contract F30602-88-C-0031)
(AD-A259627; RL-TR-92-41) Avail: CASI HC A11/MF A03

This report summarizes the third and fourth year of operation of the Northeast Parallel Architecture Center (NPAC). NPAC promotes and explores advanced computing technology by providing parallel architectures and research support to university, corporate, and government researchers nationwide. GRA

N93-23868# Technical Research Centre of Finland, Espoo. Information Processing Lab.
TIME DEPENDENT CLASSIFICATION OF FEATURES WITH A NONLINEAR, DYNAMIC NETWORK Ph.D. Thesis - Helsinki Univ.
Ari M. Vepsaelaeinen Nov. 1991 154 p Sponsored by Jenny and Antii Wihuri Foundation
(VTT-Pubs-83; ISBN-951-38-4061-1; ETN-93-93479) Copyright Avail: CASI HC A08/MF A02

A review of results and methods presented in previous publications is presented. The publications are reprinted. Temporally varying classification by a dynamic classifier network is introduced. The dynamic classifier network consists of several independent nonlinear classifiers in parallel. The subclassifiers adapt to the measurements with a variety of adaptation rates. The output of the classifier network can be calculated as a weighted sum of the outputs of each subclassifier. Two methods to optimize the weighting are given. However, even a simple weighting function gives reasonable results. The network might be considered as a temporal associative memory. Because of nonlinearities and the ensuring chaos the behavior of the network can be very complicated. Algorithms to calculate the fractal and correlation dimension are given. With these dimensions the algorithms can estimate how complicated the behavior of a system is and how many parameters are needed to describe its behavior. An extension of geodesic distance transform called distance transform in curved space, is presented. This transform can for example, be used to model dynamic decision manifolds. Some new properties of fractals are presented. These properties can be utilized efficiently when defining the Lyapunov exponents and the basins of attraction for maps. The methods presented have several application areas. ESA

N93-23872# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
DISTRIBUTED COMPUTER SYSTEMS AND LOGISTICS SYSTEMS: WHAT DO THEY HAVE IN COMMON BESIDES DISTRIBUTION?
Leonard Franken and Boudewijn R. Haverkort 1992 32 p
(Memo-INF-92-44; TIOS-92-20; TI-RA-92-918; ETN-93-93200) Copyright Avail: CASI HC A03/MF A01

The nature of distributed computer systems and logistics systems is discussed and the question as to what makes these systems distributed is answered. Various reasons for the distributed nature such as scalability, availability increase, performance increase, the distributed nature of the applications etc., are given. The design trajectory for both types of systems is compared. A number of common aspects are recognized. To clearly identify the similarities and differences, a common framework for distributed computer systems and logistics sustems is presented. The role of quantitative analysis in the lifecycle of these systems is shown. It turns out that Quality of Service aspects (QoS) play an important role in all phases of the system lifecycle, and consequently, that quantitative analysis for the determination of the QoS plays an important role in all phases of the system lifecycle. However, quantitative aspects are not the only aspects of importance. Functional aspects (correctness, etc.), especially in combination with quantitative analysis, are of importance. This combinatiion is relatively new. No well established modeling frameworks have been defined for this purpose yet. A number of attempts in this direction are reported, together with work done on software tools which effectively support these combined methods in the design and reconfiguration of distributed systems. ESA

N93-23873# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
IMPLEMENTATION AND PERFORMANCE EVALUATION OF A PARALLEL TRANSITIVE CLOSURE ALGORITHM ON PRISMA/DB
Maurice A. W. Houtsma, Annita N. Wilschut, and Jan Flokstra Jun. 1992 22 p Sponsored in part by Royal Netherlands Academy of Arts and Sciences
(Memo-INF-92-45; ETN-93-93201) Copyright Avail: CASI HC A03/MF A01

An experimental performance study of the parallel computation of transitive closure operations on a parallel database system is described. This work brings two research efforts together: the development of an efficient execution strategy for the parallel computation of path problems,

called the Disconnection Set Approach; and the development and implementation of a parallel, main memory DBMS (Data Base Management System), called PRISMA/DB. The implementation of the disconnection set approach on PRISMA/DB is reported, showing how the latter's design allowed the easy extension of the functionality of the system. It is shown that the parallel implementation of the disconnection set approach yields good performance characteristics, and that linear speedup with respect to a special purpose single processor algorithm is achieved. A number of experiments that show to what extent data fragmentation issues influence the performance of the disconnection set approach are described. ESA

N93-23999# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.

MATCH AND MOVE: AN APPROACH TO DATA PARALLEL COMPUTING Ph.D. Thesis

Thomas J. Sheffler Oct. 1992 232 p

(Contract F33615-90-C-1465; ARPA Order 7597)

(AD-A259915; CMU-CS-92-203) Avail: CASI HC A11/MF A03

The match operation, introduced by G. Sabot, is a parallel primitive describing a communication pattern. For two vectors of keys, called the 'source' and 'destination,' a path is indicated for each element of the source to each destination element having an equal key. The result of the match operation is a data structure called a 'mapping' encapsulating these paths. A move operation sends data from the sites of a source data vector through the paths of the mapping to a destination data vector. If the mapping is many-to-one, a combining function, such as add, max, or min, specifies how collisions are resolved at the destination sites. The match and move operations provide a unified set of parallel primitives that at once satisfy the conflicting demands of generality and efficiency. The generality of the approach is illustrated by showing many algorithms implemented with match, focusing on algorithms for graphs, sparse matrices, and binary tree structures. These types of problems are characterized as involving dynamic structural change, and are typically difficult to implement on parallel architectures. By using the framework allowed by the match operation, the algorithms are straightforward and simple to understand. Because match and move may be implemented efficiently on many different parallel and vector architectures, algorithms expressed in this manner achieve architecture independence. In addition, because there are many implementation strategies for the operators available for a given machine, they provide a level of implementation independence. This level of abstraction is supported without sacrificing absolute performance, however. GRA

N93-24039# Electronics Research Lab., Adelaide (Australia).

SHIVA MARK 2 HARDWARE ARCHITECTURE, VERSION 1

D. A. Krnak, A. J. Yakovleff, J. D. Yesberg, M. S. Anderson, and P. C. Drewer Aug. 1992 39 p

(AD-A259534; ERL-0631-GD; DODA-AR-006-970) Avail: CASI HC A03/MF A01

This document describes the hardware aspects of the Shiva multiprocessor, which has a dynamically reconfigurable architecture and supports heterogeneity. The system is meant to be used as an accelerator for computationally intensive tasks, and is used in conjunction with a workstation. GRA

N93-24630# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.

UNIVERSAL CHANNEL NETWORK, OR COMBINING THE BEST OF TOKEN RING AND SLOTTED RING

H. L. Pasch and I. G. Niemegeers 1992 24 p

(MEMO-INF-92-41; TIOS-92-17; ETN-93-93197) Copyright Avail: CASI HC A03/MF A01

Two access mechanisms complementary in performance, the token ring and the slotted ring, are discussed. While the token ring outperforms the slotted ring for long messages, the latter performs significantly better for short messages. The factor that causes this difference is the number of tokens in the ring. A Universal Channel Network (UCN) design is proposed, in which the number of tokens was made adaptive, resulting in a network that can be made to behave like both the token ring and the slotted ring, or anything in between. UCN performs optimally for any given message length. It is shown how the number of tokens influences the behavior of the UCN, and its performance is compared with that of the token ring and the slotted ring. Its performance is then compared with that of DQDB (Distributed Queue Dual Bus) and FDDI (Fiber Distributed Data Interface) using several different configurations that are representative for MAN's (Metropolitan Area Networks). It is determined how configuration parameters like transmission, rate, and network length influence the performance of the networks. The workload model used is a detailed representation of a typical today's traffic, extrapolated to the future. Because of the uncertainty concerning future MAN traffic, two versions of the workload model are used. In the first version, voice and video sources are modeled as constant bit rate sources. In the second version, variable bit rate sources are used to represent voice and video sources. The network performance for both coding techniques is compared. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N93-22206*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

PROCEEDINGS OF THE THIRD INTERNATIONAL WORKSHOP ON NEURAL NETWORKS AND FUZZY LOGIC, VOLUME 2

Christopher J. Culbert, ed. Jan. 1993 183 p Workshop held in Houston, TX, 1-3 Jun. 1992 Sponsored in part by Houston Univ.

(NASA-CP-10111-Vol-2; S-701-Vol-2; NAS 1.55:10111-Vol-2) Avail: CASI HC A09/MF A02

Papers presented at the Neural Networks and Fuzzy Logic Workshop sponsored by the National Aeronautics and Space Administration and cosponsored by the University of Houston, Clear Lake, held 1-3 Jun. 1992 at the Lyndon B. Johnson Space Center in Houston, Texas are included. During the three days approximately 50 papers were presented. Technical topics addressed included adaptive systems; learning algorithms; network architectures; vision; robotics; neurobiological connections; speech recognition and synthesis; fuzzy set theory and application, control and dynamics processing; space applications; fuzzy logic and neural network computers; approximate reasoning; and multiobject decision making. For individual titles, see N93-22207 through N93-22223.

N93-22207*# University of West Florida, Pensacola. Computer Science Div.

TWO GENERALIZATIONS OF KOHONEN CLUSTERING

James C. Bezdek, Nikhil R. Pal (Indian Statistical Inst., Calcutta.), and Eric C. K. Tsao *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 199-226 (For primary document see N93-22206 08-63)

(Grant NSF IRI-90-03252)

Avail: CASI HC A03/MF A02

The relationship between the sequential hard c-means (SHCM), learning vector quantization (LVQ), and fuzzy c-means (FCM) clustering algorithms is discussed. LVQ and SHCM suffer from several major problems. For example, they depend heavily on initialization. If the initial values of the cluster centers are outside the convex hull of the input data, such algorithms, even if they terminate, may not produce meaningful results in terms of prototypes for cluster representation. This is due in part to the fact that they update only the winning prototype for every input vector. The impact and interaction of these two families with Kohonen's self-organizing feature mapping (SOFM), which is not a clustering method, but which often leads ideas to clustering algorithms is discussed. Then two generalizations of LVQ that are explicitly designed as clustering algorithms are presented; these algorithms are referred to as generalized LVQ = GLVQ; and fuzzy LVQ = FLVQ. Learning rules are derived to optimize an objective function whose goal is to produce 'good clusters'. GLVQ/FLVQ (may) update every node in the clustering net for each input vector. Neither GLVQ nor FLVQ depends upon a choice for the update neighborhood or learning rate distribution - these are taken care of automatically. Segmentation of a gray tone image is used as a typical application of these algorithms to illustrate the performance of GLVQ/FLVQ. Author (revised)

N93-22208*# Research Inst. for Computing and Information Systems, Houston, TX.
POSSIBILISTIC CLUSTERING FOR SHAPE RECOGNITION
James M. Keller (Missouri Univ., Columbia.) and Raghu Krishnapuram (Missouri Univ., Columbia.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 227-236 Previously announced as N93-18228 (For primary document see N93-22206 08-63)
Avail: CASI HC A02/MF A02

Clustering methods have been used extensively in computer vision and pattern recognition. Fuzzy clustering has been shown to be advantageous over crisp (or traditional) clustering in that total commitment of a vector to a given class is not required at each iteration. Recently fuzzy clustering methods have shown spectacular ability to detect not only hypervolume clusters, but also clusters which are actually 'thin shells', i.e., curves and surfaces. Most analytic fuzzy clustering approaches are derived from Bezdek's Fuzzy C-Means (FCM) algorithm. The FCM uses the probabilistic constraint that the memberships of a data point across classes sum to one. This constraint was used to generate the membership update equations for an iterative algorithm. Unfortunately, the memberships resulting from FCM and its derivatives do not correspond to the intuitive concept of degree of belonging, and moreover, the algorithms have considerable trouble in noisy environments. Recently, the clustering problem was cast into the framework of possibility theory. Our approach was radically different from the existing clustering methods in that the resulting partition of the data can be interpreted as a possibilistic partition, and the membership values may be interpreted as degrees of possibility of the points belonging to the classes. An appropriate objective function whose minimum will characterize a good possibilistic partition of the data was constructed, and the membership and prototype update equations from necessary conditions for minimization of our criterion function were derived. The ability of this approach to detect linear and quartic curves in the presence of considerable noise is shown. Author (revised)

N93-22209*# Togai InfraLogic, Inc., Houston, TX.
APPLICATION OF GENETIC ALGORITHMS TO TUNING FUZZY CONTROL SYSTEMS
Todd Espy, Endre Vombrack, and Jack Aldridge *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 237-248 (For primary document see N93-22206 08-63)
(Contract NAS9-18527)
Avail: CASI HC A03/MF A02

Real number genetic algorithms (GA) were applied for tuning fuzzy membership functions of three controller applications. The first application is our 'Fuzzy Pong' demonstration, a controller that controls a very responsive system. The performance of the automatically tuned membership functions exceeded that of manually tuned membership functions both when the algorithm started with randomly generated functions and with the best manually-tuned functions. The second GA tunes input membership functions to achieve a specified control surface. The third application is a practical one, a motor controller for a printed circuit manufacturing system. The GA alters the positions and overlaps of the membership functions to accomplish the tuning. The applications, the real number GA approach, the fitness function and population parameters, and the performance improvements achieved are discussed. Directions for further research in tuning input and output membership functions and in tuning fuzzy rules are described. Author (revised)

N93-22210*# Hosei Univ., Tokyo (Japan). Dept. of Instrument and Control Engineering.
THE 3-D IMAGE RECOGNITION BASED ON FUZZY NEURAL NETWORK TECHNOLOGY
Kaoru Hirota, Kenichi Yamauchi, Jun Murakami, and Kei Tanaka *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 249-256 Sponsored in part by Science and Technology Agency (For primary document see N93-22206 08-63)
Avail: CASI HC A02/MF A02

Three dimensional stereoscopic image recognition system based on fuzzy-neural network technology was developed. The system consists of three parts; preprocessing part, feature extraction part, and matching part. Two CCD color camera image are fed to the preprocessing part, where several operations including RGB-HSV transformation are done. A multi-layer perception is used for the line detection in the feature extraction part. Then fuzzy matching technique is introduced in the matching part. The system is realized on SUN spark station and special image input hardware system. An experimental result on bottle images is also presented. Author (revised)

N93-22211*# Matsushita Electric Industrial Co. Ltd., Osaka (Japan). Central Research Labs.
A PROPOSAL OF FUZZY CONNECTIVE WITH LEARNING FUNCTION AND ITS APPLICATION TO FUZZY RETRIEVAL SYSTEM
Isao Hayashi, Eiichi Naito, Jun Ozawa, and Noboru Wakami *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 257-271 Sponsored in part by Science and Technology Agency (For primary document see N93-22206 08-63)
Avail: CASI HC A03/MF A02

A new fuzzy connective and a structure of network constructed by fuzzy connectives are proposed to overcome a drawback of conventional fuzzy retrieval systems. This network represents a retrieval query and the fuzzy connectives in networks have a learning function to adjust its parameters by data from a database and outputs of a user. The fuzzy retrieval systems employing this network are also constructed. Users can retrieve results even with a query whose attributes do not exist in a database schema and can get satisfactory results for variety of thinkings by learning function. Author (revised)

N93-22212*# Exxon Production Research Company, Houston, TX.
APPLICATION OF FUZZY SET AND DEMPSTER-SHAFER THEORY TO ORGANIC GEOCHEMISTRY INTERPRETATION
C. S. Kim and G. H. Isaksen *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 273-281 (For primary document see N93-22206 08-63)
Avail: CASI HC A02/MF A02

An application of fuzzy sets and Dempster Shafter Theory (DST) in modeling the interpretational process of organic geochemistry data for predicting the level of maturities of oil and source rock samples is presented. This was accomplished by (1) representing linguistic imprecision and imprecision associated with experience by a fuzzy set theory, (2) capturing the probabilistic nature of imperfect evidences by a DST, and (3) combining multiple evidences by utilizing John Yen's generalized Dempster-Shafter Theory (GDST), which allows DST to deal with fuzzy information. The current prototype provides collective beliefs on the predicted levels of maturity by combining multiple evidences through GDST's rule of combination. Author (revised)

N93-22213*# Tulsa Univ., OK. Mathematical and Computer Sciences.
TOWARDS AUTONOMOUS FUZZY CONTROL
Sujeet Shenoi and Arthur Ramer (New South Wales Univ., Kensington, Australia.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 282-284 Sponsored in part by OCAST and Sun Microsystems, Inc. (For primary document see N93-22206 08-63)
(Grant NSF IRI-91-10709)
Avail: CASI HC A01/MF A02

The efficient implementation of on-line adaptation in real time is an important research problem in fuzzy control. The goal is to develop autonomous self-organizing controllers employing system-independent control meta-knowledge which enables them to adjust their control policies depending on the systems they control and the environments in which they operate. An autonomous fuzzy controller would continuously observe system behavior while implementing its control actions and would use the outcomes of these actions to refine its control policy. It could be designed to lie dormant when its control actions give rise to adequate performance characteristics but could rapidly and autonomously initiate real-time adaptation whenever its performance degrades. Such an autonomous fuzzy controller would have immense practical value. It could accommodate individual variations in system characteristics and also compensate for degradations in system characteristics caused by wear and tear. It could also potentially deal with black-box systems and control scenarios. On-going

research in autonomous fuzzy control is reported. The ultimate research objective is to develop robust and relatively inexpensive autonomous fuzzy control hardware suitable for use in real time environments.
Author (revised)

N93-22214*# Houston Univ., TX. Dept. of Electrical Engineering.
DETERMINING THE NUMBER OF HIDDEN UNITS IN MULTI-LAYER PERCEPTRONS USING F-RATIOS
Ben H. Jansen and Pratish R. Desai *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 285-294 (For primary document see N93-22206 08-63)
Avail: CASI HC A02/MF A02

The hidden units in multi-layer perceptrons are believed to act as feature extractors. In other words, the outputs of the hidden units represent the features in a more traditional statistical classification paradigm. This viewpoint offers a statistical, objective approach to determining the optimal number of hidden units required. This approach is based on an F-ratio test, and proceeds in an iterative fashion. The method and its application to simulated time-series data are presented.
Author

N93-22215*# Cincinnati Univ., OH. Dept. of Electrical and Computer Engineering.
A NEW APPROACH FOR DESIGNING SELF-ORGANIZING SYSTEMS AND APPLICATION TO ADAPTIVE CONTROL
P. A. Ramamoorthy, Shi Zhang, Yueqing Lin, and Song Huang *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 295-308 (For primary document see N93-22206 08-63)
Avail: CASI HC A03/MF A02

There is tremendous interest in the design of intelligent machines capable of autonomous learning and skillful performance under complex environments. A major task in designing such systems is to make the system plastic and adaptive when presented with new and useful information and stable in response to irrelevant events. A great body of knowledge, based on neuro-physiological concepts, has evolved as a possible solution to this problem. Adaptive resonance theory (ART) is a classical example under this category. The system dynamics of an ART network is described by a set of differential equations with nonlinear functions. An approach for designing self-organizing networks characterized by nonlinear differential equations is proposed.
Author (revised)

N93-22216*# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering.
ADAPTIVE FUZZY SYSTEM FOR 3-D VISION Final Report, 1 Apr. 1991 - 31 Mar. 1992
Sunanda Mitra *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 309-327 Sponsored in part by Northrop Corp. and Texas Instruments, Inc. (For primary document see N93-22206 08-63)
(Grant NAG9-509)
Avail: CASI HC A03/MF A02

An adaptive fuzzy system using the concept of the Adaptive Resonance Theory (ART) type neural network architecture and incorporating fuzzy c-means (FCM) system equations for reclassification of cluster centers was developed. The Adaptive Fuzzy Leader Clustering (AFLC) architecture is a hybrid neural-fuzzy system which learns on-line in a stable and efficient manner. The system uses a control structure similar to that found in the Adaptive Resonance Theory (ART-1) network to identify the cluster centers initially. The initial classification of an input takes place in a two stage process; a simple competitive stage and a distance metric comparison stage. The cluster prototypes are then incrementally updated by relocating the centroid positions from Fuzzy c-Means (FCM) system equations for the centroids and the membership values. The operational characteristics of AFLC and the critical parameters involved in its operation are discussed. The performance of the AFLC algorithm is presented through application of the algorithm to the Anderson Iris data, and laser-luminescent fingerprint image data. The AFLC algorithm successfully classifies features extracted from real data, discrete or continuous, indicating the potential strength of this new clustering algorithm in analyzing complex data sets. The hybrid neuro-fuzzy AFLC algorithm will enhance analysis of a number of difficult recognition and control problems involved with Tethered Satellite Systems and on-orbit space shuttle attitude controller.
Author (revised)

N93-22217*# Houston Univ., TX.
FUZZY LOGIC PATH PLANNING SYSTEM FOR COLLISION AVOIDANCE BY AN AUTONOMOUS ROVER VEHICLE Abstract Only
Michael G. Murphy *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 328-329 (For primary document see N93-22206 08-63)
Avail: CASI HC A01/MF A02

The Space Exploration Initiative of the United States will make great demands upon NASA and its limited resources. One aspect of great importance will be providing for autonomous (unmanned) operation of vehicles and/or subsystems in space flight and surface exploration. An additional, complicating factor is that much of the need for autonomy of operation will take place under conditions of great uncertainty or ambiguity. Issues in developing an autonomous collision avoidance subsystem within a path planning system for application in a remote, hostile environment that does not lend itself well to remote manipulation by Earth-based telecommunications is addressed. A good focus is unmanned surface exploration of Mars. The uncertainties involved indicate that robust approaches such as fuzzy logic control are particularly appropriate. Four major issues addressed are (1) avoidance of a fuzzy moving obstacle; (2) backoff from a deadend in a static obstacle environment; (3) fusion of sensor data to detect obstacles; and (4) options for adaptive learning in a path planning system. Examples of the need for collision avoidance by an autonomous rover vehicle on the surface of Mars with a moving obstacle would be wind-blown debris, surface flow or anomalies due to subsurface disturbances, another vehicle, etc. The other issues of backoff, sensor fusion, and adaptive learning are important in the overall path planning system.
Author (revised)

N93-22218*# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
DRIVING A CAR WITH CUSTOM-DESIGNED FUZZY INFERENCING VLSI CHIPS AND BOARDS
Francois G. Pin and Yutaka Watanabe *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 330-342 (For primary document see N93-22206 08-63)
(Contract DE-AC05-84OR-21400)
Avail: CASI HC A03/MF A02

Vehicle control in a-priori unknown, unpredictable, and dynamic environments requires many calculational and reasoning schemes to operate on the basis of very imprecise, incomplete, or unreliable data. For such systems, in which all the uncertainties can not be engineered away, approximate reasoning may provide an alternative to the complexity and computational requirements of conventional uncertainty analysis and propagation techniques. Two types of computer boards including custom-designed VLSI chips were developed to add a fuzzy inferencing capability to real-time control systems. All inferencing rules on a chip are processed in parallel, allowing execution of the entire rule base in about 30 microseconds, and therefore, making control of 'reflex-type' of motions envisionable. The use of these boards and the approach using superposition of elemental sensor-based behaviors for the development of qualitative reasoning schemes emulating human-like navigation in a-priori unknown environments are first discussed. Then how the human-like navigation scheme implemented on one of the qualitative inferencing boards was installed on a test-bed platform to investigate two control modes for driving a car in a-priori unknown environments on the basis of sparse and imprecise sensor data is described. In the first mode, the car navigates fully autonomously, while in the second mode, the system acts as a driver's aid providing the driver with linguistic (fuzzy) commands to turn left or right and speed up or slow down depending on the obstacles perceived by the sensors. Experiments with both modes of control are described in which the system uses only three acoustic range (sonar) sensor channels to perceive the environment. Simulation results as well as indoors and outdoors experiments are presented and discussed to illustrate the feasibility and robustness of autonomous navigation and/or safety enhancing driver's aid using the new fuzzy inferencing hardware system and some human-like

reasoning schemes which may include as little as six elemental behaviors embodied in fourteen qualitative rules. Author (revised)

N93-22219*# SRI International Corp., Menlo Park, CA. Artificial Intelligence Center.

AUTONOMOUS VEHICLE MOTION CONTROL, APPROXIMATE MAPS, AND FUZZY LOGIC Abstract Only

Enrique H. Ruspini *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 343 (For primary document see N93-22206 08-63)

Avail: CASI HC A01/MF A02

Progress on research on the control of actions of autonomous mobile agents using fuzzy logic is presented. The innovations described encompass theoretical and applied developments. At the theoretical level, results of research leading to the combined utilization of conventional artificial planning techniques with fuzzy logic approaches for the control of local motion and perception actions are presented. Also formulations of dynamic programming approaches to optimal control in the context of the analysis of approximate models of the real world are examined. Also a new approach to goal conflict resolution that does not require specification of numerical values representing relative goal importance is reviewed. Applied developments include the introduction of the notion of approximate map. A fuzzy relational database structure for the representation of vague and imprecise information about the robot's environment is proposed. Also the central notions of control point and control structure are discussed. Author (revised)

N93-22220*# Texas A&M Univ., College Station. Dept. of Computer Science.

A FUZZY LOGIC CONTROLLER FOR AN AUTONOMOUS MOBILE ROBOT Abstract Only

John Yen and Nathan Pfluger *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 344-345 (For primary document see N93-22206 08-63)

Avail: CASI HC A01/MF A02

The ability of a mobile robot system to plan and move intelligently in a dynamic system is needed if robots are to be useful in areas other than controlled environments. An example of a use for this system is to control an autonomous mobile robot in a space station, or other isolated area where it is hard or impossible for human life to exist for long periods of time (e.g., Mars). The system would allow the robot to be programmed to carry out the duties normally accomplished by a human being. Some of the duties that could be accomplished include operating instruments, transporting objects, and maintenance of the environment. The main focus of our early work has been on developing a fuzzy controller that takes a path and adapts it to a given environment. The robot only uses information gathered from the sensors, but retains the ability to avoid dynamically placed obstacles near and along the path. Our fuzzy logic controller is based on the following algorithm: (1) determine the desired direction of travel; (2) determine the allowed direction of travel; and (3) combine the desired and allowed directions in order to determine a direciton that is both desired and allowed. The desired direction of travel is determined by projecting ahead to a point along the path that is closer to the goal. This gives a local direction of travel for the robot and helps to avoid obstacles. Author (revised)

N93-22221*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

INTELLIGENT NEUROPROCESSORS FOR IN-SITU LAUNCH VEHICLE PROPULSION SYSTEMS HEALTH MANAGEMENT Abstract Only

S. Gulati, R. Tawel, and A. P. Thakoor *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 346-347 (For primary document see N93-22206 08-63)

Avail: CASI HC A01/MF A02

Efficacy of existing on-board propulsion systems health management systems (HMS) are severely impacted by computational limitations (e.g., low sampling rates); paradigmatic limitations (e.g., low-fidelity logic/parameter redlining only, false alarms due to noisy/corrupted sensor signatures, preprogrammed diagnostics only); and telemetry bandwidth limitations on space/ground interactions. Ultra-compact/light, adaptive neural networks with massively parallel, asynchronous, fast reconfigurable and fault-tolerant information processing properties have already demonstrated significant potential for inflight diagnostic analyses and resource allocation with reduced ground dependence. In particular, they can automatically exploit correlation effects across multiple sensor streams (plume analyzer, flow meters, vibration detectors, etc.) so as to detect anomaly signatures that cannot be determined from the exploitation of single sensor. Furthermore, neural networks have already demonstrated the potential for impacting real-time fault recovery in vehicle subsystems by adaptively regulating combustion mixture/power subsystems and optimizing resource utilization under degraded conditions. A class of high-performance neuroprocessors, developed at JPL, that have demonstrated potential for next-generation HMS for a family of space transportation vehicles envisioned for the next few decades, including HLLV, NLS, and space shuttle is presented. Of fundamental interest are intelligent neuroprocessors for real-time plume analysis, optimizing combustion mixture-ratio, and feedback to hydraulic, pneumatic control systems. This class includes concurrently asynchronous reprogrammable, nonvolatile, analog neural processors with high speed, high bandwidth electronic/optical I/O interfaced, with special emphasis on NASA's unique requirements in terms of performance, reliability, ultra-high density ultra-compactness, ultra-light weight devices, radiation hardened devices, power stringency, and long life terms. Author (revised)

N93-22222*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.

SYNTHESIS OF NONLINEAR CONTROL STRATEGIES FROM FUZZY LOGIC CONTROL ALGORITHMS

Reza Langari *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 348-353 (For primary document see N93-22206 08-63)

Avail: CASI HC A02/MF A02

Fuzzy control has been recognized as an alternative to conventional control techniques in situations where the plant model is not sufficiently well known to warrant the application of conventional control techniques. Precisely what fuzzy control does and how it does what it does is not quite clear, however. This important issue is discussed and in particular it is shown how a given fuzzy control scheme can resolve into a nonlinear control law and that in those situations the success of fuzzy control hinges on its ability to compensate for nonlinearities in plant dynamics. Author (revised)

N93-22223*# National Univ. of Singapore. Inst. of Systems Science.

TRUTH-VALUED-FLOW INFERENCE (TVFI) AND ITS APPLICATIONS IN APPROXIMATE REASONING

Pei-Zhuang Wang (Beijing Normal Univ., China.), Hongmin Zhang (Aptronix Fuzzy Logic Technology Co., San Jose, CA.), and Wei Xu (Aptronix Fuzzy Logic Technology Co., San Jose, CA.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 2 Jan. 1993 p 354-367 (For primary document see N93-22206 08-63)

Avail: CASI HC A03/MF A02

The framework of the theory of Truth-valued-flow Inference (TVFI) is introduced. Even though there are dozens of papers presented on fuzzy reasoning, we think it is still needed to explore a rather unified fuzzy reasoning theory which has the following two features: (1) it is simplified enough to be executed feasibly and easily; and (2) it is well structural and well consistent enough that it can be built into a strict mathematical theory and is consistent with the theory proposed by L.A. Zadeh. TVFI is one of the fuzzy reasoning theories that satisfies the above two features. It presents inference by the form of networks, and naturally views inference as a process of truth values flowing among propositions. Author (revised)

N93-22351*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

PROCEEDINGS OF THE THIRD INTERNATIONAL WORKSHOP ON NEURAL NETWORKS AND FUZZY LOGIC, VOLUME 1

Christopher J. Culbert, ed. Jan. 1993 211 p Workshop held in Houston, TX, 1-3 Jun. 1992 Sponsored in part by Houston Univ. (NASA-CP-10111-Vol-1; S-701-Vol-1; NAS 1.55:10111-Vol-1) Avail: CASI HC A10/MF A03

Documented here are papers presented at the Neural Networks and Fuzzy Logic Workshop sponsored by the National Aeronautics and Space

Administration and cosponsored by the University of Houston, Clear Lake. The workshop was held June 1-3, 1992 at the Lyndon B. Johnson Space Center in Houston, Texas. During the three days approximately 50 papers were presented. Technical topics addressed included adaptive systems; learning algorithms; network architectures; vision; robotics; neurobiological connections; speech recognition and synthesis; fuzzy set theory and application, control, and dynamics processing; space applications; fuzzy logic and neural network computers; approximate reasoning; and multiobject decision making. For individual titles, see N93-22352 through N93-22378.

N93-22352*# General Electric Co., Schenectady, NY. Artificial Intelligence Lab.

FUZZY LOGIC CONTROLLERS: A KNOWLEDGE-BASED SYSTEM PERSPECTIVE

Piero P. Bonissone *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 1-2 (For primary document see N93-22351 08-63)

Avail: CASI HC A01/MF A03

Over the last few years we have seen an increasing number of applications of Fuzzy Logic Controllers. These applications range from the development of auto-focus cameras, to the control of subway trains, cranes, automobile subsystems (automatic transmissions), domestic appliances, and various consumer electronic products. In summary, we consider a Fuzzy Logic Controller to be a high level language with its local semantics, interpreter, and compiler, which enables us to quickly synthesize non-linear controllers for dynamic systems. Derived from text

N93-22353*# Los Alamos National Lab., NM.

EFFICIENTLY MODELING NEURAL NETWORKS ON MASSIVELY PARALLEL COMPUTERS

Robert M. Farber *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 3-12 Prepared in cooperation with Santa Fe Inst., NM (For primary document see N93-22351 08-63)

(Grant GM-40789-03)

Avail: CASI HC A02/MF A03

Neural networks are a very useful tool for analyzing and modeling complex real world systems. Applying neural network simulations to real world problems generally involves large amounts of data and massive amounts of computation. To efficiently handle the computational requirements of large problems, we have implemented at Los Alamos a highly efficient neural network compiler for serial computers, vector computers, vector parallel computers, and fine grain SIMD computers such as the CM-2 connection machine. This paper describes the mapping used by the compiler to implement feed-forward backpropagation neural networks for a SIMD (Single Instruction Multiple Data) architecture parallel computer. Thinking Machines Corporation has benchmarked our code at 1.3 billion interconnects per second (approximately 3 gigaflops) on a 64,000 processor CM-2 connection machine (Singer 1990). This mapping is applicable to other SIMD computers and can be implemented on MIMD computers such as the CM-5 connection machine. Our mapping has virtually no communications overhead with the exception of the communications required for a global summation across the processors (which has a sub-linear runtime growth on the order of O(log(number of processors)). We can efficiently model very large neural networks which have many neurons and interconnects and our mapping can extend to arbitrarily large networks (within memory limitations) by merging the memory space of separate processors with fast adjacent processor interprocessor communications. This paper will consider the simulation of only feed forward neural network although this method is extendable to recurrent networks.

Derived from text

N93-22354*# University of South Florida, Tampa. Dept. of Computer Science and Engineering.

LEARNING FUZZY INFORMATION IN A HYBRID CONNECTIONIST, SYMBOLIC MODEL

Steve G. Romaniuk and Lawrence O. Hall *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 13-29 (For primary document see N93-22351 08-63)

Avail: CASI HC A03/MF A03

An instance-based learning system is presented. SC-net is a fuzzy hybrid connectionist, symbolic learning system. It remembers some examples and makes groups of examples into exemplars. All real-valued attributes are represented as fuzzy sets. The network representation and learning method is described. To illustrate this approach to learning in fuzzy domains, an example of segmenting magnetic resonance images of the brain is discussed. Clearly, the boundaries between human tissues are ill-defined or fuzzy. Example fuzzy rules for recognition are generated. Segmentations are presented that provide results that radiologists find useful. Author

N93-22355*# Houston Univ., TX. Dept. of Electrical Engineering.

ON THE NEURAL SUBSTRATES LEADING TO THE EMERGENCE OF MENTAL OPERATIONAL STRUCTURES

H. Ogmen *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 30-39 (For primary document see N93-22351 08-63)

Avail: CASI HC A02/MF A03

A developmental approach to the study of the emergence of mental operational structures in neural networks is presented. Neural architectures proposed to underlie the six stages of the sensory-motor period are discussed. Author

N93-22356*# Texas Univ., Galveston. Dept. of Physiology and Biophysics.

A FUZZY CONTROLLER WITH NONLINEAR CONTROL RULES IS THE SUM OF A GLOBAL NONLINEAR CONTROLLER AND A LOCAL NONLINEAR PI-LIKE CONTROLLER

Hao Ying *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 40-47 (For primary document see N93-22351 08-63)

Avail: CASI HC A02/MF A03

The fuzzy controllers studied in this paper are the ones that employ N trapezoidal-shaped members for input fuzzy sets, Zadeh fuzzy logic and a centroid defuzzification algorithm for output fuzzy set. The author analytically proves that the structure of the fuzzy controllers is the sum of a global nonlinear controller and a local nonlinear proportional-integral-like controller. If N approaches infinity, the global controller becomes a nonlinear controller while the local controller disappears. If linear control rules are used, the global controller becomes a global two-dimensional multilevel relay which approaches a global linear proportional-integral (PI) controller as N approaches infinity. Author (revised)

N93-22357*# Togai InfraLogic, Inc., Houston, TX.

FUZZY CONTROL OF SMALL SERVO MOTORS Abstract Only

Ron Maor and Yashvant Jani *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 48 (For primary document see N93-22351 08-63)

Avail: CASI HC A01/MF A03

To explore the benefits of fuzzy logic and understand the differences between the classical control methods and fuzzy control methods, the Togai InfraLogic applications engineering staff developed and implemented a motor control system for small servo motors. The motor assembly for testing the fuzzy and conventional controllers consist of servo motor RA13M and an encoder with a range of 4096 counts. An interface card was designed and fabricated to interface the motor assembly and encoder to an IBM PC. The fuzzy logic based motor controller was developed using the TILShell and Fuzzy C Development System on an IBM PC. A Proportional-Derivative (PD) type conventional controller was also developed and implemented in the IBM PC to compare the performance with the fuzzy controller. Test cases were defined to include step inputs of 90 and 180 degrees rotation, sine and square wave profiles in 5 to 20 hertz frequency range, as well as ramp inputs. In this paper we describe our approach to develop a fuzzy as well as PH controller, provide details of hardware set-up and test cases, and discuss the performance results. In comparison, the fuzzy logic based controller handles the non-linearities of the motor assembly very well and provides excellent control over a broad range of parameters. Fuzzy technology, as indicated by our results, possesses inherent adaptive features. Author

N93-22358*# Iona Coll., New Rochelle, NY. Machine Intelligence Inst.
A HIERARCHICAL STRUCTURE FOR REPRESENTING AND LEARNING FUZZY RULES
Ronald R. Yager *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 49-53 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

Yager provides an example in which the flat representation of fuzzy if-then rules leads to unsatisfactory results. Consider a rule base consisting to two rules: if U is 12 the V is 29; if U is (10-15) the V is (25-30). If U = 12 we would get V is G where G = (25-30). The application of the defuzzification process leads to a selection of V = 27.5. Thus we see that the very specific instruction was not followed. The problem with the technique used is that the most specific information was swamped by the less specific information. In this paper we shall provide for a new structure for the representation of fuzzy if-then rules. The representational form introduced here is called a Hierarchical Prioritized Structure (HPS) representation. Most importantly in addition to overcoming the problem illustrated in the previous example this HPS representation has an inherent capability to emulate the learning of general rules and provides a reasonable accurate cognitive mapping of how human beings store information.
Author (revised)

N93-22359*# Houston Univ., TX. Dept. of Applied Mathematical Sciences.
CERTAIN AND POSSIBLE RULES FOR DECISION MAKING USING ROUGH SET THEORY EXTENDED TO FUZZY SETS
Andre deKorvin and Margaret F. Shipley *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 54-68 (For primary document see N93-22351 08-63)
Avail: CASI HC A03/MF A03

Uncertainty may be caused by the ambiguity in the terms used to describe a specific situation. It may also be caused by skepticism of rules used to describe a course of action or by missing and/or erroneous data. To deal with uncertainty, techniques other than classical logic need to be developed. Although, statistics may be the best tool available for handling likelihood, it is not always adequate for dealing with knowledge acquisition under uncertainty. Inadequacies caused by estimating probabilities in statistical processes can be alleviated through use of the Dempster-Shafer theory of evidence. Fuzzy set theory is another tool used to deal with uncertainty where ambiguous terms are present. Other methods include rough sets, the theory of endorsements and nonmonotonic logic. J. Grzymala-Busse has defined the concept of lower and upper approximation of a (crisp) set and has used that concept to extract rules from a set of examples. We will define the fuzzy analogs of lower and upper approximations and use these to obtain certain and possible rules from a set of examples where the data is fuzzy. Central to these concepts will be the idea of the degree to which a fuzzy set A is contained in another fuzzy set B, and the degree of intersection of a set A with set B. These concepts will also give meaning to the statement; A implies B. The two meanings will be: (1) if x is certainly in A then it is certainly in B, and (2) if x is possibly in A then it is possibly in B. Next, classification will be looked at and it will be shown that if a classification will be looked at and it will be shown that if a classification is well externally definable then it is well internally definable, and if it is poorly externally definable then it is poorly internally definable, thus generalizing a result of Grzymala-Busse. Finally, some ideas of how to define consensus and group options to form clusters of rules will be given.
Derived from text

N93-22360*# Texas Univ., San Antonio. Engineering Div.
ON STRUCTURING THE RULES OF A FUZZY CONTROLLER
Jun Zhou and G. V. S. Raju *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 69-72 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

Since the pioneering work of Zadeh and Mamdani and Assilian, fuzzy logic control has emerged as one of the most active and fruitful research areas. The applications of fuzzy logic control can be found in many fields such as control of stream generators, automatic train operation systems, elevator control, nuclear reactor control, automobile transmission control, etc. In this paper, two new structures of hierarchical fuzzy rule-based controller are proposed to reduce the number of rules in a complete rule set of a controller. In one approach, the overall system is split into sub-systems which are treated independently in parallel. A coordinator is then used to take into account the interactions. This is done via an iterating information exchange between the lower level and the coordinator level. From the point of view of information used, this structure is very similar to central structure in that the coordinator can have at least in principle, all the information that the local controllers have.
Derived from text

N93-22361*# KT-Tech, Inc., Seabrook, MD.
ROBUST ALGEBRAIC IMAGE ENHANCEMENT FOR INTELLIGENT CONTROL SYSTEMS Abstract Only
Bao-Ting Lerner and Michael Morrelli (Texas Technological Univ., Lubbock.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 73-74 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

Robust vision capability for intelligent control systems has been an elusive goal in image processing. The computationally intensive techniques a necessary for conventional image processing make real-time applications, such as object tracking and collision avoidance difficult. In order to endow an intelligent control system with the needed vision robustness, an adequate image enhancement subsystem capable of compensating for the wide variety of real-world degradations, must exist between the image capturing and the object recognition subsystems. This enhancement stage must be adaptive and must operate with consistency in the presence of both statistical and shape-based noise. To deal with this problem, we have developed an innovative algebraic approach which provides a sound mathematical framework for image representation and manipulation. Our image model provides a natural platform from which to pursue dynamic scene analysis, and its incorporation into a vision system would serve as the front-end to an intelligent control system. We have developed a unique polynomial representation of gray level imagery and applied this representation to develop polynomial operators on complex gray level scenes. This approach is highly advantageous since polynomials can be manipulated very easily, and are readily understood, thus providing a very convenient environment for image processing. Our model presents a highly structured and compact algebraic representation of grey-level images which can be viewed as fuzzy sets.
Derived from text

N93-22362*# Texas A&M Univ., College Station. Center for Fuzzy Logic and Intelligent Systems Research.
DESIGN ISSUES FOR A REINFORCEMENT-BASED SELF-LEARNING FUZZY CONTROLLER Abstract Only
John Yen, Haojin Wang, and Walter Dauherity *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 75 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

Fuzzy logic controllers have some often cited advantages over conventional techniques such as PID control: easy implementation, its accommodation to natural language, the ability to cover wider range of operating conditions and others. One major obstacle that hinders its broader application is the lack of a systematic way to develop and modify its rules and as result the creation and modification of fuzzy rules often depends on try-error or pure experimentation. One of the proposed approaches to address this issue is self-learning fuzzy logic controllers (SFLC) that use reinforcement learning techniques to learn the desirability of states and to adjust the consequent part of fuzzy control rules accordingly. Due to the different dynamics of the controlled processes, the performance of self-learning fuzzy controller is highly contingent on the design. The design issue has not received sufficient attention. The issues related to the design of a SFLC for the application to chemical process are discussed and its performance is compared with that of PID and self-tuning fuzzy logic controller.
Author

N93-22363*# Togai InfraLogic, Inc., Houston, TX.
FUZZY EFFICIENCY OPTIMIZATION OF AC INDUCTION MOTORS
Yashvant Jani, Gilberto Sousa (Tennessee Univ., Knoxville.), Wayne Turner (Research Triangle Inst., Research Triangle Park, NC.), Ron Spiegel

(Environmental Protection Agency, Research Triangle Park, NC.), and Jeff Chappell (Environmental Protection Agency, Research Triangle Park, NC.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 76-92 (For primary document see N93-22351 08-63)
Avail: CASI HC A03/MF A03

This paper describes the early states of work to implement a fuzzy logic controller to optimize the efficiency of AC induction motor/adjustable speed drive (ASD) systems running at less than optimal speed and torque conditions. In this paper, the process by which the membership functions of the controller were tuned is discussed and a controller which operates on frequency as well as voltage is proposed. The membership functions for this dual-variable controller are sketched. Additional topics include an approach for fuzzy logic to motor current control which can be used with vector-controlled drives. Incorporation of a fuzzy controller as an application-specific integrated circuit (ASIC) microchip is planned. Author

N93-22364*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ADVANCED TELEROBOTIC CONTROL USING NEURAL NETWORKS Abstract Only
Robert M. Pap (Accurate Automation Corp., Chattanooga, TN.), Mark Atkins (Accurate Automation Corp., Chattanooga, TN.), Chadwick Cox (Accurate Automation Corp., Chattanooga, TN.), Charles Glover (Tennessee State Univ., Nashville.), Ralph Kissel, and Richard Saeks (Accurate Automation Corp., Chattanooga, TN.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 93-94 Sponsored in part by ONR and NSF (For primary document see N93-22351 08-63)
(Contract NAS8-38967)
Avail: CASI HC A01/MF A03

Accurate Automation is designing and developing adaptive decentralized joint controllers using neural networks. We are then implementing these in hardware for the Marshall Space Flight Center PFMA as well as to be usable for the Remote Manipulator System (RMS) robot arm. Our design is being realized in hardware after completion of the software simulation. This is implemented using a Functional-Link neural network.
Derived from text

N93-22365*# Laboratory for International Fuzzy Engineering Research, Yokohama (Japan).
MULTI-LAYERED REASONING BY MEANS OF CONCEPTUAL FUZZY SETS
Tomohiro Takagi, Atsushi Imura, Hirohide Ushida, and Toru Yamaguchi *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 95-106 (For primary document see N93-22351 08-63)
Avail: CASI HC A03/MF A03

The real world consists of a very large number of instances of events and continuous numeric values. On the other hand, people represent and process their knowledge in terms of abstracted concepts derived from generalization of these instances and numeric values. Logic based paradigms for knowledge representation use symbolic processing both for concept representation and inference. Their underlying assumption is that a concept can be defined precisely. However, as this assumption hardly holds for natural concepts, it follows that symbolic processing cannot deal with such concepts. Thus symbolic processing has essential problems from a practical point of view of applications in the real world. In contrast, fuzzy set theory can be viewed as a stronger and more practical notation than formal, logic based theories because it supports both symbolic processing and numeric processing, connecting the logic based world and the real world. In this paper, we propose multi-layered reasoning by using conceptual fuzzy sets (CFS). The general characteristics of CFS are discussed along with upper layer supervision and context dependent processing.
Derived from text

N93-22366*# Tokyo Inst. of Tech., Yokahama (Japan). Dept. of Systems Science.
FUZZY CONTROL OF AN UNMANNED HELICOPTER Abstract Only
M. Sugeno, J. Nishino, and H. Miwa *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 107 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

This paper discusses an application of fuzzy control to an unmanned helicopter. The authors design a fuzzy controller to achieve semi-autonomous flight of a helicopter by giving macroscopic flight commands from the ground. The fuzzy controller proposed in this study consists of two layers: the upper layer for navigation supervising the lower layer and the lower layer for ordinary rule based control. The performance of the fuzzy controller is evaluated in experiments where an industrial helicopter Yamaha R-50 is used. At present an operator can wirelessly control the helicopter through a flight computer with eight commands such as 'hover', 'fly forward', 'turn left', 'stop', etc. Author (revised)

N93-22367*# Sikorsky Aircraft, Stratford, CT. Advanced Research and Design.
FUZZY LOGIC MODE SWITCHING IN HELICOPTERS Abstract Only
Porter D. Sherman and Frank W. Warburton *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 108 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

The application of fuzzy logic to a wide range of control problems has been gaining momentum internationally, fueled by a concentrated Japanese effort. Advanced Research & Development within the Engineering Department at Sikorsky Aircraft undertook a fuzzy logic research effort designed to evaluate how effective fuzzy logic control might be in relation to helicopter operations. The mode switching module in the advanced flight control portion of Sikorsky's motion based simulator was identified as a good candidate problem because it was simple to understand and contained imprecise (fuzzy) decision criteria. The purpose of the switching module is to aid a helicopter pilot in entering and leaving coordinated turns while in flight. The criteria that determine the transitions between modes are imprecise and depend on the varied ranges of three flight conditions (i.e., simulated parameters): Commanded Rate, Duration, and Roll Attitude. The parameters were given fuzzy ranges and used as input variables to a fuzzy rulebase containing the knowledge of mode switching. The fuzzy control program was integrated into a real time interactive helicopter simulation tool. Optimization of the heading hold and turn coordination was accomplished by interactive pilot simulation testing of the handling quality performance of the helicopter dynamic model. The fuzzy logic code satisfied all the requirements of this candidate control problem.
Author (revised)

N93-22368*# McDonnell Aircraft Co., Saint Louis, MO.
A NEURAL BASED INTELLIGENT FLIGHT CONTROL SYSTEM FOR THE NASA F-15 FLIGHT RESEARCH AIRCRAFT **c08**
James M. Urnes, Stephen E. Hoy, Robert N. Ladage, and James Stewart *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 109-112 Prepared for NASA. Dryden Flight Research Facility, Edwards, CA (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

A flight control concept that can identify aircraft stability properties and continually optimize the aircraft flying qualities has been developed by McDonnell Aircraft Company under a contract with the NASA-Dryden Flight Research Facility. This flight concept, termed the Intelligent Flight Control System, utilizes Neural Network technology to identify the host aircraft stability and control properties during flight, and use this information to design on-line the control system feedback gains to provide continuous optimum flight response. This self-repairing capability can provide high performance flight maneuvering response throughout large flight envelopes, such as needed for the National Aerospace Plane. Moreover, achieving this response early in the vehicle's development schedule will save cost.
Derived from text

N93-22369*# Army Aviation Systems Command, Hampton, VA. Aerostructures Directorate.
A TELEOPERATED UNMANNED ROTORCRAFT FLIGHT TEST TECHNIQUE **c08**
Gregory W. Walker, Arthur E. Phelps, III, and W. Todd Hodges *In* NASA. Johnson Space Center, Proceedings of the Third International

Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 113-126 (For primary document see N93-22351 08-63)
Avail: CASI HC A03/MF A03

NASA and the U.S. Army are jointly developing a teleoperated unmanned rotorcraft research platform at the National Aeronautics and Space Administration (NASA) Langley Research Center. This effort is intended to provide the rotorcraft research community an intermediate step between wind tunnel rotorcraft studies and full scale flight testing. The research vehicle is scaled such that it can be operated in the NASA Langley 14- by 22-Foot Subsonic Tunnel or be flown freely at an outside test range. This paper briefly describes the system's requirements and the techniques used to marry the various technologies present in the system to meet these requirements. The paper also discusses the status of the development effort. Author

N93-22370*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE TIME NEURAL NETWORKS FOR TETHER OPERATIONS IN SPACE
Robert N. Lea, James A. Villarreal, Yashvant Jani (Togai InfraLogic, Inc., Houston, TX.), and Charles Copeland (Loral Space Information Systems, Houston, TX.) *In its* Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 127-168 (For primary document see N93-22351 08-63)
Avail: CASI HC A03/MF A03

A space shuttle flight scheduled for 1992 will attempt to prove the feasibility of operating tethered payloads in earth orbit. due to the interaction between the Earth's magnetic field and current pulsing through the tether, the tethered system may exhibit a circular transverse oscillation referred to as the 'skiprope' phenomenon. Effective damping of skiprope motion depends on rapid and accurate detection of skiprope magnitude and phase. Because of non-linear dynamic coupling, the satellite attitude behavior has characteristic oscillations during the skiprope motion. Since the satellite attitude motion has many other perturbations, the relationship between the skiprope parameters and attitude time history is very involved and non-linear. We propose a Space-Time Neural Network implementation for filtering satellite rate gyro data to rapidly detect and predict skiprope magnitude and phase. Training and testing of the skiprope detection system will be performed using a validated Orbital Operations Simulator and Space-Time Neural Network software developed in the Software Technology Branch at NASA's Lyndon B. Johnson Space Center. Author (revised)

N93-22371*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STRUCTURE IDENTIFICATION IN FUZZY INFERENCE USING REINFORCEMENT LEARNING Abstract Only
Hamid R. Berenji (Sterling Software, Moffett Field, CA.) and Pratap Khedkar (California Univ., Berkeley.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 169 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

In our previous work on the GARIC architecture, we have shown that the system can start with surface structure of the knowledge base (i.e., the linguistic expression of the rules) and learn the deep structure (i.e., the fuzzy membership functions of the labels used in the rules) by using reinforcement learning. Assuming the surface structure, GARIC refines the fuzzy membership functions used in the consequents of the rules using a gradient descent procedure. This hybrid fuzzy logic and reinforcement learning approach can learn to balance a cart-pole system and to backup a truck to its docking location after a few trials. In this paper, we discuss how to do structure identification using reinforcement learning in fuzzy inference systems. This involves identifying both surface as well as deep structure of the knowledge base. The term set of fuzzy linguistic labels used in describing the values of each control variable must be derived. In this process, splitting a label refers to creating new labels which are more granular than the original label and merging two labels creates a more general label. Splitting and merging of labels directly transform the structure of the action selection network used in GARIC by increasing or decreasing the number of hidden layer nodes. Author (revised)

N93-22372*# Alabama Univ., Birmingham. Dept. of Mathematics.
APPROXIMATION PAPER, PART 1
J. J. Buckley *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 170-173 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

In this paper we discuss approximations between neural nets, fuzzy expert systems, fuzzy controllers, and continuous processes. Author

N93-22373*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
NONLINEAR RESCALING OF CONTROL VALUES SIMPLIFIES FUZZY CONTROL
H. VanLangingham, A. Tsoukkas, V. Kreinovich (Texas Univ., El Paso.), and C. Quintana (Texas Univ., El Paso.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 174-182 Sponsored in part by Inst. for Manufacturing and Materials Management (For primary document see N93-22351 08-63)
(Contract NAG9-482; N00014-89-J-3123; NSF CDA-90-15006)
Avail: CASI HC A02/MF A03

Traditional control theory is well-developed mainly for linear control situations. In non-linear cases there is no general method of generating a good control, so we have to rely on the ability of the experts (operators) to control them. If we want to automate their control, we must acquire their knowledge and translate it into a precise control strategy. The experts' knowledge is usually represented in non-numeric terms, namely, in terms of uncertain statements of the type 'if the obstacle is straight ahead, the distance to it is small, and the velocity of the car is medium, press the brakes hard'. Fuzzy control is a methodology that translates such statements into precise formulas for control. The necessary first step of this strategy consists of assigning membership functions to all the terms that the expert uses in his rules (in our sample phrase these words are 'small', 'medium', and 'hard'). The appropriate choice of a membership function can drastically improve the quality of a fuzzy control. In the simplest cases, we can take the functions whose domains have equally spaced endpoints. Because of that, many software packages for fuzzy control are based on this choice of membership functions. This choice is not very efficient in more complicated cases. Therefore, methods have been developed that use neural networks or generic algorithms to 'tune' membership functions. But this tuning takes lots of time (for example, several thousands iterations are typical for neural networks). In some cases there are evident physical reasons why equally space domains do not work: e.g., if the control variable u is always positive (i.e., if we control temperature in a reactor), then negative values (that are generated by equal spacing) simply make no sense. In this case it sounds reasonable to choose another scale u' = f(u) to represent u, so that equal spacing will work fine for u'. In the present paper we formulate the problem of finding the best rescaling function, solve this problem, and show (on a real-life example) that after an optimal rescaling, the un-tuned fuzzy control can be as good as the best state-of-art traditional non-linear controls. Author (revised)

N93-22374*# Alabama Univ., Tuscaloosa. Dept. of Engineering Mechanics.
GENETIC LEARNING IN RULE-BASED AND NEURAL SYSTEMS Abstract Only
Robert E. Smith *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 183 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

The design of neural networks and fuzzy systems can involve complex, nonlinear, and ill-conditioned optimization problems. Often, traditional optimization schemes are inadequate or inapplicable for such tasks. Genetic Algorithms (GA's) are a class of optimization procedures whose mechanics are based on those of natural genetics. Mathematical arguments show how GAs bring substantial computational leverage to search problems, without requiring the mathematical characteristics often necessary for traditional optimization schemes (e.g., modality, continuity, availability of derivative information, etc.). GA's have proven effective in a variety of search tasks that arise in neural networks and fuzzy systems. This presentation begins by introducing the mechanism and theoretical

underpinnings of GA's. GA's are then related to a class of rule-based machine learning systems called learning classifier systems (LCS's). An LCS implements a low-level production-system that uses a GA as its primary rule discovery mechanism. This presentation illustrates how, despite its rule-based framework, an LCS can be thought of as a competitive neural network. Neural network simulator code for an LCS is presented. In this context, the GA is doing more than optimizing and objective function. It is searching for an ecology of hidden nodes with limited connectivity. The GA attempts to evolve this ecology such that effective neural network performance results. The GA is particularly well adapted to this task, given its naturally-inspired basis. The LCS/neural network analogy extends itself to other, more traditional neural networks. Conclusions to the presentation discuss the implications of using GA's in ecological search problems that arise in neural and fuzzy systems. Author

N93-22375*# Instituto Technologico y de Estudios Superiores de Monterrey (Mexico). Center for Artificial Intelligence.
EVOLVING FUZZY RULES IN A LEARNING CLASSIFIER SYSTEM
Manuel Valenzuela-Rendon *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 184-185 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

The fuzzy classifier system (FCS) combines the ideas of fuzzy logic controllers (FLC's) and learning classifier systems (LCS's). It brings together the expressive powers of fuzzy logic as it has been applied in fuzzy controllers to express relations between continuous variables, and the ability of LCS's to evolve co-adapted sets of rules. The goal of the FCS is to develop a rule-based system capable of learning in a reinforcement regime, and that can potentially be used for process control. Derived from text

N93-22376*# Bureau of Mines, Tuscaloosa, AL.
ADAPTIVE PROCESS CONTROL USING FUZZY LOGIC AND GENETIC ALGORITHMS
C. L. Karr *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 186-193 (For primary document see N93-22351 08-63)
Avail: CASI HC A02/MF A03

Researchers at the U.S. Bureau of Mines have developed adaptive process control systems in which genetic algorithms (GA's) are used to augment fuzzy logic controllers (FLC's). GA's are search algorithms that rapidly locate near-optimum solutions to a wide spectrum of problems by modeling the search procedures of natural genetics. FLC's are rule based systems that efficiently manipulate a problem environment by modeling the 'rule-of-thumb' strategy used in human decision making. Together, GA's and FLC's possess the capabilities necessary to produce powerful, efficient, and robust adaptive control systems. To perform efficiently, such control systems require a control element to manipulate the problem environment, and a learning element to adjust to the changes in the problem environment. Details of an overall adaptive control system are discussed. A specific laboratory acid-base pH system is used to demonstrate the ideas presented. Author (revised)

N93-22377*# California Univ., Berkeley. Computer Science Div.
DESIGN OF FUZZY SYSTEM BY NNs AND REALIZATION OF ADAPTABILITY
Hideyuki Takagi (Matsushita Electric Industrial Co. Ltd., Moriguchi, Japan.) *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 194-195 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

The issue of designing and tuning fuzzy membership functions by neural networks (NN's) was started by NN-driven Fuzzy Reasoning in 1988. NN-driven fuzzy reasoning involves a NN embedded in the fuzzy system which generates membership values. In conventional fuzzy system design, the membership functions are hand-crafted by trial and error for each input variable. In contrast, NN-driven fuzzy reasoning considers several variables simultaneously and can design a multidimensional, nonlinear membership function for the entire subspace. Derived from text

N93-22378*# Duke Univ., Durham, NC. Dept. of Electrical Engineering.
IMPROVEMENT ON FUZZY CONTROLLER DESIGN TECHNIQUES Abstract Only
Paul P. Wang *In* NASA. Johnson Space Center, Proceedings of the Third International Workshop on Neural Networks and Fuzzy Logic, Volume 1 Jan. 1993 p 196 (For primary document see N93-22351 08-63)
Avail: CASI HC A01/MF A03

This paper addresses three main issues, which are somewhat interrelated. The first issue deals with the classification or types of fuzzy controllers. Careful examination of the fuzzy controllers designed by various engineers reveals distinctive classes of fuzzy controllers. Classification is believed to be helpful from different perspectives. The second issue deals with the design according to specifications, experiments related to the tuning of fuzzy controllers, according to the specification, will be discussed. General design procedure, hopefully, can be outlined in order to ease the burden of a design engineer. The third issue deals with the simplicity and limitation of the rule-based IF-THEN logical statements. The methodology of fuzzy-constraint network is proposed here as an alternative to the design practice at present. It is our belief that predicate calculus and the first order logic possess much more expressive power. Author (revised)

N93-22396*# Research Inst. for Computing and Information Systems, Houston, TX.
APPLICATION OF FUZZY LOGIC-NEURAL NETWORK BASED REINFORCEMENT LEARNING TO PROXIMITY AND DOCKING OPERATIONS: TRANSLATIONAL CONTROLLER RESULTS
Yashvant Jani (Togai InfraLogic, Inc., Houston, TX.) 15 Nov. 1992 342 p
(Contract NCC9-16; RICIS Proj. AR-06)
(NASA-CR-192320; NAS 1.26:192320) Avail: CASI HC A15/MF A03

The reinforcement learning techniques developed at Ames Research Center are being applied to proximity and docking operations using the Shuttle and Solar Maximum Mission (SMM) satellite simulation. In utilizing these fuzzy learning techniques, we also use the Approximate Reasoning based Intelligent Control (ARIC) architecture, and so we use two terms interchangeable to imply the same. This activity is carried out in the Software Technology Laboratory utilizing the Orbital Operations Simulator (OOS). This report is the deliverable D3 in our project activity and provides the test results of the fuzzy learning translational controller. This report is organized in six sections. Based on our experience and analysis with the attitude controller, we have modified the basic configuration of the reinforcement learning algorithm in ARIC as described in section 2. The shuttle translational controller and its implementation in fuzzy learning architecture is described in section 3. Two test cases that we have performed are described in section 4. Our results and conclusions are discussed in section 5, and section 6 provides future plans and summary for the project. Author

N93-22756# Sandia National Labs., Albuquerque, NM.
PATH PLANNING FOR MANIPULATORS
P. C. Chen 1992 8 p Presented at the 5th Topical Meeting on Robotics and Remote Systems, Knoxville, TN, 26-29 Apr. 1993
(Contract DE-AC04-76DP-00789)
(DE93-004050; SAND-92-1437C; CONF-930403-6) Avail: CASI HC A02/MF A01

To facilitate robot programming, three different path planners with complementary capabilities are presented. The first planner uses SANDROS, a new search strategy that combines hierarchical, nonuniform-multi-resolution, and best-first search to find a near-optimal solution in the configuration space. It is an efficient and resolution-complete algorithm that has performance commensurate with task difficulty. The second planner uses a simpler path planning algorithm based on a series of plausible task restrictions. It is designed to solve 'realistic' problems very quickly, at the expense of not being able to solve every problem. Finally, the third planner uses a learning algorithm designed to improve path planning. The learning algorithm not only reduces the time cost of existing planners, but also increases their capability in solving difficult tasks. DOE

N93-23060# Technische Univ., Delft (Netherlands). Lab. for Measurement and Control.
IDENTIFICATION FOR ROBUST CONTROL: WHAT IS THE BEST APPROACH?
D. K. deVries 1991 57 p
(MEMT-16; ISBN-90-370-0058-4; ETN-93-92009) Copyright Avail: CASI HC A04/MF A01

The problem of identifying a system in such a way that the identification result is suited to serve as a basis for the design of a robust controller, and that guarantees can be given on the stability and performance of the closed loop system, is addressed. Attention is restricted to exponentially stable finite dimensional linear time invariant discrete time systems in combination with the H infinity design methodology for designing robust controllers. The basic problem is stated, analyzed and detailed, leading to a set of requirements on and desirable properties of the identification method. The advantages and disadvantages of the basic approaches to the problem, stochastic or deterministic, and time or frequency domain, are analyzed. Preliminaries and a survey of literature are given. Based on the foregoing, the deterministic frequency domain approach to the problem is chosen. The problems present in this approach are discussed and some promising possibilities to solve these problems are presented. ESA

N93-23084*# Research Inst. for Computing and Information Systems, Houston, TX.
APPLICATION OF FUZZY LOGIC-NEURAL NETWORK BASED REINFORCEMENT LEARNING TO PROXIMITY AND DOCKING OPERATIONS: ATTITUDE CONTROL RESULTS Report, 1 May - 30 Jun. 1992
Yashvant Jani (Togai InfraLogic, Inc., Houston, TX.) 10 Jul. 1992 496 p
(Contract NCC9-16; RICIS Proj. AR-06)
(NASA-CR-192291; NAS 1.26:192291) Avail: CASI HC A21/MF A04

As part of the RICIS activity, the reinforcement learning techniques developed at Ames Research Center are being applied to proximity and docking operations using the Shuttle and Solar Max satellite simulation. This activity is carried out in the software technology laboratory utilizing the Orbital Operations Simulator (OOS). This report is deliverable D2 Altitude Control Results and provides the status of the project after four months of activities and outlines the future plans. In section 2 we describe the Fuzzy-Learner system for the attitude control functions. In section 3, we provide the description of test cases and results in a chronological order. In section 4, we have summarized our results and conclusions. Our future plans and recommendations are provided in section 5. Author

N93-23201 Maryland Univ., College Park.
ADAPTIVE CONTROL OF A FLEXIBLE MANIPULATOR Ph.D. Thesis
Ki-Hyun Sung 1992 197 p
Avail: Univ. Microfilms Order No. DA9234668

This research is concerned with the control of the tip position of a flexible manipulator carrying variable payload. The tip of the manipulator considered here has three degrees of freedom, viz, one rotational and two translational. The desired rotational motion is the result of a command whereas the undesired translational motions are due to the deflection caused by the payload. For this work, these three motions are decoupled since the flexible manipulator does not move simultaneously and that the translational motions are much smaller compared to the rotational motion. A self-tuning adaptive control was chosen to control the rotational motion whereas a conventional PID control was sufficient for the control of two translation motions. As a first step in developing a self-tuning control system, a single link flexible manipulator was experimentally investigated. From these tests, it was found that the dynamic behavior of a single link flexible manipulator can be adequately modeled with just one mode shape. Such a dynamic equation results in a fourth order linear model. A recursive least square algorithm was used to identify the parameters. Numerical problems of the algorithm were overcome by introducing a scale factor and a time varying forgetting factor. The self-tuning control algorithm associated with the modified parameter estimation scheme was implemented with the 'selspot' system to control the rotational motion of the tip of the flexible manipulator. For the remaining two translational motions, the PID control algorithms were developed and fine tuned. The resulting control system was evaluated by performing analytical simulations. Also, simulation was conducted to study the relative merits of using different geometry for the flexible manipulator. Three different types of flexible manipulator, viz, rectangular cross-sectional beam, circular cross-sectional beam, and I-section beam were considered. The I-section beam was found to be superior with its fastest cycle time in the theta and the z-axis motions. The overall simulation results demonstrated the ability of the developed control system to maneuver the flexible manipulator so that the tip reaches the target position accurately under varying payloads. Dissert. Abstr.

N93-23223 Minnesota Univ., Minneapolis.
GOAL DIRECTED ROBOT NAVIGATION IN A KNOWN INDOOR ENVIRONMENT WITH UNKNOWN STATIONARY AND MOVING OBSTACLES Ph.D. Thesis
Steven James Ratering 1992 129 p
Avail: Univ. Microfilms Order No. DA9236972

Robot navigation is difficult even in known environments because of the almost unavoidable presence of unknown obstacles. A new type of artificial potential field used to navigate a robot in situations in which the environment is known except for unknown and possibly moving obstacles is proposed. The potential field is called a hybrid potential field because it is composed of a static global artificial potential field which pulls the robot to the goal and a dynamic local artificial potential field which pushes the robot away from obstacles. The causes of local minima in hybrid potential fields are determined and methods for getting out of these minima are proposed. It is shown how to compute hybrid potential fields in real time and how to use them to control the motions of a real robot. The method is tested on both a simulated robot and a real one. Extensive simulation results with up to fifty randomly moving obstacles were determined. Dissert. Abstr.

N93-23288# Tennessee Univ., Knoxville. Dept. of Nuclear Engineering.
A STOCHASTIC LEARNING ALGORITHM FOR LAYERED NEURAL NETWORKS
E. B. Bartlett (Iowa State Univ. of Science and Technology, Ames.) and R. E. Uhrig 1992 7 p Presented at the WNN-92: Workshop on Neural Networks, Alburn, AL, 10-12 Feb. 1992
(Contract DE-FG07-88ER-12824)
(DE93-003555; CONF-9202142-2) Avail: CASI HC A02/MF A01

The random optimization method typically uses a Gaussian probability density function (PDF) to generate a random search vector. In this paper the random search technique is applied to the neural network training problem and is modified to dynamically seek out the optimal probability density function (OPDF) from which to select the search vector. The dynamic OPDF search process, combined with an auto-adaptive stratified sampling technique and a dynamic node architecture (DNA) learning scheme, completes the modifications of the basic method. The DNA technique determines the appropriate number of hidden nodes needed for a given training problem. By using DNA, researchers do not have to set the neural network architectures before training is initiated. The approach is applied to networks of generalized, fully interconnected, continuous perceptions. Computer simulation results are given. DOE

N93-23338# Oak Ridge National Lab., TN.
TIME OPTIMAL PATHS FOR HIGH SPEED MANEUVERING
D. B. Reister and S. M. Lenhart Jan. 1993 38 p
(Contract DE-AC05-84OR-21400)
(DE93-006251; ORNL/TM-12289) Avail: CASI HC A03/MF A01

Recent theoretical results have completely solved the problem of determining the minimum length path for a vehicle with a minimum turning radius moving from an initial configuration to a final configuration. Time optimal paths for a constant speed vehicle are a subset of the minimum length paths. The Pontryagin maximum principle is used to find time optimal paths for a constant speed vehicle. The time optimal paths consist of sequences of axes of circles and straight lines. The maximum principle introduces concepts (dual variables, bang-bang solutions, singular solutions, and transversality conditions) that provide important insight into the nature of the time optimal paths. The properties of the optimal paths are explored and some experimental results for a mobile robot following an optimal path are presented. DOE

N93-23355# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.

A PASSIVITY APPROACH TO CONTROLLER-OBSERVER DESIGN FOR ROBOTS

Harry Berghuis and H. Nijmeijer Apr. 1992 34 p Sponsored by Netherlands Technology Foundation

(MEMO-1050; ETN-93-93190) Avail: CASI HC A03/MF A01

A design procedure that utilizes the passivity concept in order to develop combined controller observer systems for robot motion control using position measurements only is proposed. To this end, a desired energy function for the closed loop system is introduced, and the controller observer combination is constructed such that the closed loop system matches this energy function, whereas damping is included in the controller observer system to assure asymptotic stability of the closed loop system. A key point in this design procedure is a fine tuning of the controller and observer structure to each other, which provides solutions to the output feedback robot control problem that are conceptually simple and easily implementable in industrial robot applications. Performance issues of the overall control systems are illustrated in a simulation study of a two degrees of freedom robot manipulator. ESA

N93-23362# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.

A SELF GROWING BINARY TREE NEURAL NETWORK FOR THE IDENTIFICATION OF MULTICLASS SYSTEMS

K. M. Tsang (Hong Kong Polytechnic, Kowloon.) and S. A. Billings Mar. 1992 29 p

(RR-451; ETN-93-93492) Avail: CASI HC A03/MF A01

A self growing binary tree neural network is introduced for the online identification of multiclass systems. Instead of solving the traditional two class problem with a single neuron a time shrinking threshold logic unit is introduced such that the modified neuron has the capability of partitioning the raw data records into three different regions. Incorporating a least mean squares learning algorithm provides the capability of detecting and creating new classes and this allows clustering and partitioning of the raw data records into model classes and yields estimates of the parameters. The models which describe the behavior of the system at different operating regions can be recovered by inspection of the connection weights of the individual neurons. Optimization procedures for online estimation are proposed. Simulation studies are included to illustrate the concepts. ESA

N93-23442# Florida Atlantic Univ., Boca Raton.

AUTONOMUS OBSTACLE AVOIDANCE USING VISUAL FIXATION AND LOOMING

Kunal Joarder and Daniel Raviv Dec. 1992 27 p Sponsored by National Inst. of Standards and Technology, Gaithersburg, MD

(PB93-146660; NISTIR-4996) Avail: CASI HC A03/MF A01

The paper describes a vision-based method for avoiding obstacles using the concepts of visual looming and fixating motion. Visual looming refers to the expansion of images of objects in the retina. Usually, this is due to the decreasing distance between the observer and the object. An increasing looming value signifies an increasing threat of collision with the object. The visual task of avoiding collision can be further simplified by purposive control of visual fixation at the objects in front of the moving camera. Using these two basic concepts, real time obstacle avoidance in a tight perception-action loop is implemented. Three-dimensional space in front of the camera is divided into zones with various degrees of looming-based threat of collision. For each obstacle seen by a fixating camera, looming and its time derivative are calculated directly from the 2D image. Depending on the threat posed by an obstacle, a course change is dictated. This looming based approach is simple, independent of the size of the 3D object and its range, and involves simple quantitative measurements. Results pertinent to a camera on a robot arm navigating between obstacles are presented. GRA

N93-23443# Massachusetts Inst. of Tech., Cambridge. Marine Industry Collegium.

PERCEPTION, SCENE RECONSTRUCTION AND WORLD MODELING FOR UNMANNED UNDERWATER VEHICLES

John Moore, Jr., ed. Jan. 1993 36 p Workshop held in Cambridge, MA, 26-27 Jan. 1993 Sponsored by National Sea Grant Coll. Program, Silver Spring, MD

(PB93-146983; MITSG-92-24; Opportunity Brief-62) Avail: CASI HC A03/MF A01

The workshop addresses the sensory and perceptual issues associated with the operation of intelligent systems in an underwater environment. Topics range from low-level processing, including novel hardware approaches, through the high-level techniques for combining data from multiple sensors and different sensing modalities. Presentations primarily focus on developments in computer algorithms for sensory data processing and representation of an unmanned underwater vehicle's environment, and include: perceptual strategies; physics-based sensing and world modeling; techniques for scene reconstruction; merging data over extended periods of time; target acquisition, recognition, and classification; and the trade-offs between global modeling and task-relative perception. GRA

N93-23448# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

AUTOMATIC ANALYSIS AND SYNTHESIS OF CONTROLLERS FOR DYNAMICAL SYSTEMS BASED ON PHASE-SPACE KNOWLEDGE Ph.D. Thesis

Feng Zhao Sep. 1992 148 p

(Contract N00014-89-J-3202; NSF MIP-90-01651)

(AD-A259491; AI-TR-1385) Avail: CASI HC A07/MF A02

This thesis presents a novel design methodology for the synthesis of automatic controllers, together with a computational environment--the Control Engineer's Workbench--integrating a suite of programs that automatically analyze and design controllers for high-performance, global control of nonlinear systems. This work demonstrates that difficult control synthesis tasks can be automated, using programs that actively exploit and efficiently represent knowledge of nonlinear dynamics and phase space and effectively use the representation to guide and perform the control design. The Control Engineer's Workbench combines powerful numerical and symbolic computations with spatial reasoning techniques. The two major programs in the Workbench--Phase Space Navigator and MAPS--work together to model and reason about the phase-space geometry and topology of a given system, to plan global control reference trajectories, and to navigate the system along the planned trajectories. They use a novel technique of 'flow pipes' to group finite numbers of distinct behaviors into a manageable discrete set that becomes the basis for establishing the reference trajectories. As a demonstration of this approach, I exhibit the automatic design of a non controller for a maghetic levitation system. GRA

N93-23457# SRI International Corp., Menlo Park, CA.

KNOWLEDGE-BASED VISION TECHNIQUES FOR THE AUTONOMOUS LAND VEHICLE PROGRAM Final Report, Oct. 1990 - Sep. 1991

Martin A. Fischler and Robert C. Bolles Oct. 1991 65 p

(Contract DACA76-85-C-0004)

(AD-A259801; TEC-0022) Avail: CASI HC A04/MF A01

The goal of this research was to develop techniques for automatically acquiring and representing knowledge about complex cultural and natural environments for such purposes as autonomous navigation, planning, intelligence analysis, and manipulation. The research strategy was to develop representations and techniques for storing (or incrementally learning) semantic and geographic information about a specific geographic area to permit both mission planning and knowledge-based interpretation of sensed data, develop representations for natural and man-made objects, develop techniques to recommend distinctive features of these objects that can be used for recognition purposes, and develop techniques for building three-dimensional descriptions of an environment from data gathered by range or intensity sensors moving through this environment. The accomplishments in these areas are described. Near the end of the original contractual period a new task was added to evaluate the application of the cartographic stereo techniques to ground-level imagery. The strengths and weaknesses of the techniques were characterized, enhanced them based on the insights provided by the evaluation, and then evaluated the resulting systems. The enhancements and the evaluation process are briefly described. GRA

N93-23464# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

USING RECURRENT NETWORKS FOR DIMENSIONALITY REDUCTION M.S. Thesis

Michael J. Jones Sep. 1992 68 p
(Contracts N00014-89-J-3139; N00014-91-J-4038; DACA76-85-C-0010)
(AD-A259497; AI-TR-1396) Avail: CASI HC A04/MF A01

This thesis explores how recurrent neural networks can be exploited for learning certain high-dimensional mappings. Recurrent networks are shown to be as powerful as Turing machines in terms of the class of functions they can compute. Given this computational power, a natural question to ask is how recurrent networks can be used to simplify the problem of learning from examples. Some researchers have proposed using recurrent networks for learning fixed point mappings that can also be learned on a feedforward network even though learning algorithms for recurrent networks are more complex. An important question is whether recurrent networks provide an advantage over feedforward networks for such learning tasks. The main problem with learning high-dimensional functions is the curse of dimensionality which roughly states that the number of examples needed to learn a function increases exponentially with input dimension. Reducing the dimensionality of the function being learned is therefore extremely advantageous. This thesis proposes a way of avoiding the curse of dimensionality for some problems by using a recurrent network to decompose a high-dimensional function into many lower dimensional functions connected in a feedback loop and then iterating to approximate the high-dimensional function. This idea is then tested on learning a simple image segmentation algorithm given examples of segmented and unsegmented images. GRA

N93-23472# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

LOCALIZATION AND POSITIONING USING COMBINATIONS OF MODEL VIEWS

Ehud Rivlin and Ronen Basri Jul. 1992 26 p
(AD-A259734; AI-M-1376) Avail: CASI HC A03/MF A01

A method for localization and positioning in an indoor environment is presented. Localization is the act of recognizing the environment, and positioning is the act of computing the exact coordinates of a robot in the environment. The method is based on representing the scene as a set of 2D views and predicting the appearance of views by linear combinations of the model views. The method accurately approximates the appearance of scenes under weak perspective projection. Analysis of this projection as well as experimental results demonstrate that in many cases this approximation is sufficient to accurately describe the scene. When orthographic approximation is invalid, either a larger number of models can be acquired or an iterative solution to account for the perspective distortions can be employed. GRA

N93-23473# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

3D POSE FROM 3 CORRESPONDING POINTS UNDER WEAK-PERSPECTIVE PROJECTION

T. D. Alter Jul. 1992 43 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124)
(AD-A259737; AI-M-1378) Avail: CASI HC A03/MF A01

Model-based object recognition commonly involves using a minimal set of matched model and image points to compute the pose of the model in image coordinates. Furthermore, recognition systems often rely on the 'weak-perspective' imaging model in place of the perspective imaging model. Computing the pose of a model from three corresponding points under weak-perspective projection is discussed. A new solution to the problem is proposed which, like previous solutions, involves solving a biquadratic equation. Here the biquadratic is motivated geometrically and its solutions, comprised of an actual and a false solution, are interpreted graphically. The final equations take a new form, which lead to a simple expression for the image position of any unmatched model point. GRA

N93-23474# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

3D OBJECT RECOGNITION: SYMMETRY AND VIRTUAL VIEWS

Thomas Vetter, Tomaso Poggio, and H. Bulthoff Dec. 1992 7 p
(Contracts N00014-89-J-3139; N00014-91-J-4038)
(AD-A259738; AI-M-1409; CBCL-76) Avail: CASI HC A02/MF A01

Many 3D objects in the world around us are strongly constrained. For instance, not only cultural artifacts but also many natural objects are bilaterally symmetric. Human faces are an important case for which bilateral symmetry holds, at least approximatively. Can a priori information about generic constraints of this type help the task of 3D object recognition? It can be shown that theoretically such prior information reduces the amount of information needed to recognize a 3D object, since additional virtual views can be generated from given model views by the appropriate symmetry transformations. Under special conditions, a single non-accidental 'model' view is theoretically sufficient for recognition of novel views, if the object is bilaterally symmetric, whereas the theoretical minimum (under the same conditions) for a non-symmetric object is two views. In practice, it is expected that the 'virtual' views provided by the symmetry property will facilitate human recognition of novel views. Psychophysical experiments confirm that humans are better in the recognition of symmetric objects. The hypothesis of symmetry-induced virtual views together with a network model that successfully accounts for human recognition of generic 3D objects leads to predictions that we have verified with psychophysical experiments. GRA

N93-23699# Army Armament Munitions and Chemical Command, Rock Island, IL.

DEVELOPING A NEURAL NETWORK TO ACT AS A NOISE FILTER Final Report, Sep. 1991 - Sep. 1992

Ramon Rivero 2 Oct. 1992 138 p
(AD-A259515; AMCCOM-SA-R-9210) Avail: CASI HC A07/MF A02

This study uses the neural network simulator called NETS to determine if neural networks could perform a nonlinear filtering operation to remove noise from two-dimensional (2-D) data and produce a noise-free image. Application is geared toward the development and performance of neural network filters, including the development of an optional neural network architecture and the use of criteria in determining how accurate the net filtered noise to produce a noise-free image. GRA

N93-23701# Brown Univ., Providence, RI. Inst. for Brain and Neural Systems.

WHEN NETWORKS DISAGREE: ENSEMBLE METHODS FOR HYBRID NEURAL NETWORKS

Michael P. Perrone and Leon N. Cooper 20 Jan. 1993 17 p LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(Contract DAAL03-91-G-0325)
(AD-A260121; ARO-29170.1-LS) Avail: CASI HC A03/MF A01

This paper presents a general theoretical framework for ensemble methods of constructing significantly improved regression estimates. Given a population of regression estimates, we construct a hybrid estimator which is as good or better in the MSE sense than any estimator in the population. We argue that the ensemble method presented has several properties: it efficiently uses all the networks of a population - none of the networks need be discarded; it efficiently uses all the available data for training without over-fitting; it inherently performs regularization by smoothing in functional space which helps to avoid over-fitting; it utilizes local minima to construct improved estimates whereas other neural network algorithms are hindered by local minima; it is ideally suited for parallel computation; and it leads to a very useful and natural measure of the number of distinct estimators in a population. The optimal parameters of the ensemble estimator are given in closed form. Experimental results are provided which show that the ensemble method dramatically improves neural network performance on difficult real-world optical character recognition tasks. GRA

N93-23709# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

TIME-REVERSIBLE MAXWELL'S DEMON

P. A. Skordos Sep. 1992 37 p
(Contract N00014-89-J-3202; NSF MIP-90-01651)
(AD-A260170; AI-M-1346) Avail: CASI HC A03/MF A01

A time-reversible Maxwell's demon is demonstrated which creates a density difference between two chambers initialized to have equal density. The density difference is estimated theoretically and confirmed by computer simulations. It is found that the reversible Maxwell's demon compresses phase space volume even though its dynamics are time reversible. The significance of phase space volume compression in operating a microscopic heat engine is also discussed. GRA

N93-23712# Brown Univ., Providence, RI. Inst. for Brain and Neural Systems.

THREE DIMENSIONAL OBJECT RECOGNITION USING AN UNSUPERVISED NEURAL NETWORK: UNDERSTANDING THE DISTINGUISHING FEATURES

Nathan Intrator, Heinrich H. Bulthoff, Josh I. Gold, and Shimon Edelman 23 Dec. 1992 9 p

(Contract N00014-91-J-1316)

(AD-A260048; TR-63) Avail: CASI HC A02/MF A01

A novel method for feature extraction has been applied to a problem of three-dimensional object recognition (Intrator and Gold, 1991). The method is related to recent statistical theory (Huber, 1985; Friedman, 1987) and is derived from a biologically motivated computational theory (Bienenstock et al., 1982). Results of an initial study replicating recent psychophysical experiments (Bulthoff and Edelman, 1991) demonstrated the utility of the proposed method for feature extraction. We describe further experiments designed to analyze the nature of the extracted features, and their relevance to the theory and psychophysics of object recognition. GRA

N93-23716 California Univ., Santa Barbara.

NONLINEAR ADAPTIVE CONTROL OF ELECTRO-MECHANICAL SYSTEMS Ph.D. Thesis

Degang Chen 1992 124 p

Avail: Univ. Microfilms Order No. DA9237791

This thesis sets out to investigate three fundamental problems which appear frequently in the control of electro-mechanical systems. The main part of the thesis concerns the adaptive linearization of actuator dynamics. In particular, we address the timely and important issue of torque-ripple cancellation in motor control in direct-drive robot applications. After modeling the motor dynamics, we present a new adaptive linearizing controller which uses half the number of parameters used in the standard approach and has a simple structure. This is a unique nonlinear adaptive control for which conditions on exogenous signals are found to guarantee persistency of excitation. Using a new coupled Lyapunov function dynamics technique, we establish robustness to model uncertainties nonlinear in both tracking error and parameters, even when the adaptation rate is reduced. Building on this, we investigate paramter convergence in the presence of high frequency residual torque-ripple using generalized harmonic analysis. The control has been successfully implemented and experimental results demonstrate a dramatic 30dB reduction of torque-ripple. In the second part of the thesis we study robust control of multi-body mechanical systems. A robust stability condition is presented together with a simple procedure for synthesizing such robust PID controllers. A new Kharitonov-like result is proven for multi-variable PID controllers which states roughly that a controller designed for an upper bounding inertia matrix results in stable set-point regulation for all other inertias. This is generalized to a special matrix Kharitonov theorem for n-th order polynomials with matrix coefficients lying between symmetric positive definite matrices of the same shape. A counterexample shows that the result cannot be extended to arbitrary bounding matrices. The design procedure is also applied to a two link robot manipulation and simulation results confirm the theory. The last part treats a new stable inversion problem which was motivated by our study of the inverse dynamics and control of articulated flexible structures. Taking a differential geometric approach, we set up a general framework for constructing the stable inversion of nonlinear nonminimum phase systems. Using the notion of stable and unstable invariant manifolds, the inversion problem is transferred into a two-point boundary value problem. This method is also applied to output tracking and it performs much better in simulation than the nonlinear regulator approach. Dissert. Abstr.

N93-23717 Virginia Univ., Charlottesville.

THE ROBUSTNESS OF FEED-FORWARD NEURAL NETWORKS: A PRELIMINARY INVESTIGATION Ph.D. Thesis

Ali Ahmad Minai 1992 252 p

Avail: Univ. Microfilms Order No. DA9237493

Connectionist networks are distributed systems, i.e. they consist of numerous interconnected but distinctly identifiable units. Their global behavior arises as a consequence of the behavior of these individual units. This gives connectionist systems two great advantages: (1) flexibility to adapt in response to changing requirements; and (2) robustness with respect to faults in individual units. It is obvious that the art of modelling with connectionist systems should take these strengths into account. In reality, however, there has been very little research on these specific issues, and virtually none on exploring their relationship. The research reported here is a preliminary attempt at such exploration. Feed-forward neural networks with real-valued inputs and outputs (approximation networks) are being used for modelling non-linear--especially chaotic--systems. In all cases, some iterative method is used to optimize (train) these networks on finite sets of data. This process usually converges to local minima, so that several equally accurate solutions are often obtained for any given problem. Some external criterion is needed to choose between these solutions. Usually, cross-validation with a testing set is the method of choice, but this often fails to provide adequate discrimination. In this research, an additional criterion--robustness--is proposed as a means of selection. It is the contention of this research that such a criterion is well-motivated from a connectionist perspective. Informally, robustness is the ability of a system to tolerate faults in its components. In this dissertation, a very specific simple class of faults is considered: random perturbations in the outputs of single internal neurons. The main assumption is that only one neuron is perturbed during the presentation of one particular input to the network. The primary work reported here is a tractable method of characterizing the robustness of specific networks. This enables the modeller to predict the mean and variance of the deviation caused at the network output by a random perturbation process of known distribution. The approach used is based on approximating the relationship between individual neurons and network output by truncated power series expansions. A method similar to back-propagation can be used to obtain the necessary derivatives. It is shown theoretically that typical approximation networks with sigmoidal neurons allow low-order power series expansions at neuron outputs without encountering convergence problems. The empirical results bear this out. They also demonstrate that the method developed in this research is very successful in predicting the effect of random single neuron perturbations. Another aspect of the research reported here is the attempt to develop a preliminary theoretical framework for relating the performance of networks of the performance of their components. It is argued that the components of robust networks are minimally and equally relevant. This assertion leads to a consistent characterization of distributedness in network representations. Dissert. Abstr.

N93-23718 Ohio State Univ., Columbus.

FORCE DISTRIBUTION FORMULATION AND ANALYSIS FOR MULTIPLE-CONTACT POWER GRASP Ph.D. Thesis

Khalid Mirza 1992 309 p

Avail: Univ. Microfilms Order No. DA9238236

A fundamental problem concerning dexterous hands is to find an optimal grasp to securely hold an object without crushing or slipping. Furthermore, some task domains require dexterous hands to handle objects whose characteristics cannot be anticipated or are very complex to model. A type of grasp that is highly effective for these applications is the power or enveloping grasp, which is characterized by multiple points of contact between the grasped object and the surfaces of the fingers and palm. Limited research in this area is because of analytical difficulties resulting from the highly overconstrained, closed-kinematic structure due to multiple contacts. The major objectives of this research are to develop a general force distribution formulation and to perform static and dynamic stability analyses for multiple-contact power grasp. The force distribution formulation allows the object to make contact on any surface of the dexterous hand. Hand Jacobian and grasp matrices are defined for the power grasp, which relate the joint torques to the wrench on the object. A constrained optimization problem suitable for linear programming, is formulated by combining the general force distribution equations with the constraints due to friction and joint torque limits, and is represented in a concise matrix form. Using the force distribution equations, a method for static stability analysis of power grasp is developed. The quality measure of the grasp is defined in terms of the stability region which completely describes the external load resistance capability of the grasp. Various task-oriented stability criteria are also defined which optimize the stability region. A dynamic simulation algorithm is developed to study the dynamic stability properties of power grasp. It is based on a discrete-time, state variable model of a power grasp, and uses local geometric information to implement the compliant contact model with rolling, slipping and wedging effects, along with handling the changing topological structure of power grasp dynamics. A number of experiments are performed using the DIGITS Grasping System

model, which show the stability and robustness of power grasp and its effectiveness in unstructured environments with only a simple open-loop torque control. Dissert. Abstr.

N93-23862# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).

ON POSITIVE INVARIANCE AND CONSTRAINED CONTROL OF LINEAR MULTIVARIABLE SYSTEMS Ph.D. Thesis - Toulouse Univ.

Eugenio deBonaCastelanNeto 1992 145 p In FRENCH; ENGLISH summary Sponsored by Coordenacao de Aperfeicoamento de Pessoal de Nivel Superior, Brazil

(LAAS-92223; ETN-93-93685) Avail: CASI HC A07/MF A02

Some contributions in the field of constrained linear multivariable systems are presented. The basic theoretical tool used is the positive invariance property of polyhedral domains for continuous time and discrete time linear systems. For such systems, the positive invariance property of a convex polyhedron can be obtained by solving two matrix equations known as positive invariance relations. To treat the problem of constraints satisfaction for controlled systems through the use of the positive invariance property, some techniques for solving the positive invariance relations are developed. These techniques are based on closed loop eigenstructure assignment. They can be applied to both cases of constraints in state and in control vectors. The robustness of the positive invariance property is characterized with respect to parametric variations and the performance robustness for the proposed control laws is described. In the case of systems with constrained control variables, the robustness study allows the positive invariance domain to be extended when using a saturated control law. ESA

N93-24066# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

FACE RECOGNITION WITH NEURAL NETWORKS M.S. Thesis

Dennis L. Krepp Dec. 1992 123 p

(AD-A259587; AFIT/GE/Eng/92D-23) Avail: CASI HC A06/MF A02

This study investigated neural networks for face verification and classification. The research concentrated on developing a neural network based feature extractor and/or classifier to perform authorized user verification in a realistic work environment. Recognition accuracy, system assumptions, training time, and execution time were analyzed to determine the feasibility of a neural network approach. Data was collected using a camcorder and two segmentation schemes: manual segmentation and motion-based, automatic segmentation. Data consisted of over 2000, 32x32 pixel, 8 bit gray scale images of 52 subjects; each subject had two to ten days worth of images collected. Several training and test sets were created and then used to train and test the following networks: a back propagation network using the raw data as inputs, a back propagation network using Karhunen-Loeve Transform coefficients, computed from the raw, data, as inputs; and a back propagation network using features extracted by an identity network as inputs. The classification networks performed well on constrained, single day captured, data bases but performed poorly on data gathered over multiple days. For multiple days, a verification network using a single hidden layer with back propagation obtained 95 percent verification accuracy and is suitable for use in a face verification system. GRA

N93-24069# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

THE MULTI-SCALE VETO MODEL: A TWO-STAGE ANALOG NETWORK FOR EDGE DETECTION AND IMAGE RECONSTRUCTION

Lisa Dron Mar. 1992 31 p

(Contract N00014-85-K-0124; NSF MIP-91-17724)

(AD-A259600; AI-M-1320) Avail: CASI HC A03/MF A01

This paper presents the theory behind a model for a two-stage analog network for edge detection and image reconstruction to be implemented in VLSI. Edges are detected in the first stage using the multi-scale veto rule, which states that an edge is significant if and only if it passes a threshold test at each of a set of different spatial scales. The image is reconstructed in the second stage from the brightness values adjacent to the edge locations. Among the key features of this model are that edges are localized at the resolution of the smallest spatial scale without having to identify maxima in brightness gradients, while noise is removed with the efficiency of the largest scale. There are no problems of local minima, and for any given set of parameters there is a unique solution. Images reconstructed from the brightnesses adjacent to the marked edges are very similar visually to the originals. Significant bandwidth compression can thus be achieved without noticeably compromising image quality. GRA

N93-24077# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.

A NEW CONJUGATE GRADIENT METHOD FOR OPTIMAL CONTROL

K. M. Khoda and C. Storey Aug. 1992 14 p Presented at SIAM Conference on Control and Its Applications, Minneapolis, MN, 17-19 Sep. 1992

(MATHS-Rept-A-174; ETN-93-93558) Avail: CASI HC A03/MF A01

The Generalized Polak-Ribiere (GPR) algorithm for unconstrained static optimization, which takes the effect of inexact line searches into account, was developed and shown to be more efficient than some compatible algorithms. The algorithm is used in function space form to solve a number of optimal control problems of both singular and nonsingular nature. It is shown to be very efficient especially in terms of the number of iterations required for convergence, compared with existing conjugate gradient techniques. ESA

N93-24078# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.

LEARNING OPTIMAL CONTROL USING LEARNING AUTOMATA

Q. H. Wu Sep. 1992 26 p

(MATHS-Rept-A-176; ETN-93-93560) Avail: CASI HC A03/MF A01

The application of reinforcement learning techniques to the stochastic optimal control problem is addressed. A method based on learning automata for designing controllers for the control of complex dynamic systems is presented. Focus is on the design of a learning automaton using subsets of control actions to reduce the number of actions during a learning procedure. The subsets of actions can be expanded or contracted according to action probabilities which are reset from time to time so as to achieve a global selection over the action set. Two reinforcement schemes were investigated alongside the variable subsets of control actions. A reference performance index and an approach to quantification and normalization of the performance index are proposed in association with the two schemes in order to evaluate environment responses during the learning procedure. The method was used to achieve learning control for an unknown nonlinear turbogenerator system. ESA

N93-24085# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

SPACE EFFICIENT 3D MODEL INDEXING

David W. Jacobs Feb. 1992 26 p

(Contracts DACA76-85-C-0010; N00014-85-K-0124)

(AD-A259571; AI-M-1353) Avail: CASI HC A03/MF A01

We show that the set of 2D images produced by the point features of a rigid 3D model can be represented with two lines in two high-dimensional spaces. These lines are the lowest-dimensional representation possible. We use this result to build a system for representing in a hash table at compile time, all the images that groups of model features can produce. Then at run time a group of image features can access the table and find all model groups that could match it. This table is efficient in terms of space, and is built and accessed through analytic methods that account for the effect of sensing error. In real images, it reduces the set of potential matches by a factor of several thousand. We also use this representation of a model's images to analyze two other approaches to recognition: invariants, and non-accidental properties. These are properties of images that some models always produce, and all other models either never produce (invariants) or almost never produce (non-accidental properties). In several domains we determine when invariants exist. In general we show that there is an infinite set of non-accidental properties that are qualitatively similar. GRA

N93-24100# Imperial Coll. of Science and Technology, London (England). Dept. of Electrical Engineering.

DETERMINISTIC METHODS IN STOCHASTIC OPTIMAL CONTROL Final Report

Mark H. Davis and Gabriel Burstein Oct. 1992 89 p

(Contract DAJA45-90-C-0024)

(AD-A260478) Avail: CASI HC A05/MF A01

A new approach to the control of systems represented by stochastic

differential equations (SDE's) is developed in which stochastic control is viewed as deterministic control with a particular form of constraint structure. Specifically, the characteristic nonanticipativity property of the control processes is formulated as an equality constraint on the set of possibly anticipative processes. The optimal nonanticipative control is then recovered by minimizing, over the class of possibly anticipating processes, a cost function modified by the inclusion of a Lagrange multiplier term to enforce the nonanticipativity constraint. This unconstrained minimization is carried out pathwise-i.e., separately for each value of a certain random parameter and hence reduces to a parameterized family of deterministic optimal control problems. Solution of the controlled SDE's with anticipative controls are defined by a decomposition method. It is shown that the value function of the control problem is the unique global solution of a robust equation (random partial differential equation) associated to a linear backward Hamilton-Jacobi-Bellman stochastic partial differential equation (HJB SPDE). GRA

N93-24130# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

A GLOBAL APPROACH TO PARAMETER ESTIMATION OF CHAOTIC DYNAMICAL SYSTEMS Memorandum Report

Athanassios G. Siapas Dec. 1992 32 p

(Contract N00014-89-J-3202)

(AD-A259932; MIT-AIM-1402) Avail: CASI HC A03/MF A01

We present a novel approach to parameter estimation of systems with complicated dynamics, as well as evidence for the existence of a universal power law that enables us to quantify the dependence of global geometry on small changes in the parameters of the system. This power law gives rise to what seems to be a new dynamical system invariant. GRA

N93-24249# Massachusetts Inst. of Tech., Cambridge. Artificial Intellegence Lab.

WHAT MAKES A GOOD FEATURE? Memorandum Report

W. Richards and A. Jepson Apr. 1992 43 p

(Contracts DACA76-85-C-0010; N00014-85-K-0124)

(AD-A259962; AI-M-1356; CBIP-72) Avail: CASI HC A03/MF A01

Perceptual information processing systems, both biological and non-biological, often consist of very elaborate algorithms designed to extract certain features or events from the input sensory array. Such features in vision range from simple 'on-off' units to 'hand' or 'face' detectors, and are now almost countless, so many having already been discovered or in use with no obvious limit in sight. Here we attempt to place some bounds upon just what features are worth computing. Previously, others have proposed that useful features reflect 'non-accidental' or 'suspicious' configurations that are especially informative yet typical of the world (such as two parallel lines). Using a Bayesian framework, we show how these intuitions can be made more precise, and in the process show that useful feature based inferences are highly dependent upon the context in which a feature is observed. For example, an inference supported by a feature at an early stage of processing when the context is relatively open may be nonsense in a more specific context provided by subsequent 'higher-level' processing. Therefore, specification for a 'good feature' requires a specification of the model class that sets the current context. We propose a general form for the structure of a model class, and use this structure as a basis for enumerating and evaluating appropriate 'good features'. Our conclusion is that one's cognitive capacities and goals are as important a part of 'good features' as are the regularities of the world. GRA

N93-24270# Yale Univ., New Haven, CT. Dept. of Computer Science.

TRANSFORMATIONAL PLANNING OF REACTIVE BEHAVIOR

Drew McDermott Dec. 1992 71 p

(Contract N00014-91-J-1577)

(AD-A260350; YaleU/CSD/RR-941) Avail: CASI HC A04/MF A01

Reactive plans are plans that include steps for sensing the world and coping with the data so obtained. The application of AI planning techniques to plans of this sort in a simple simulated world is investigated. To achieve fast reaction times, it is assumed that the agent starts with a default reactive plan, while the planner attempts to improve it by applying plan transformations, thus searching through the space of transformed plans. When the planner has what it believes to be a better plan, it swaps the new plan into the agent's controller. The plans are written in a reactive language that allows for this kind of swapping. The language allows for concurrency, and hence, truly 'nonlinear' plans. The planner evaluates plans by projecting them, that is, generating scenarios for how execution might go. The resulting projections give estimates of plan values, but also provide clues to how the plan might be improved. These clues are unearthed by critics that go through the scenario sets, checking how the world state and the agent state evolved. The critics suggest plan transformations with associated estimates of how much they will improve the plan. Plan transformations must be able to edit code trees in such a way that the changes are orthogonal and reversible whenever possible. The system was tested by comparing the performance of the agent with and without planning. Preliminary results allow us to conclude that the planner can be fast and directed enough to generate improved plans in a timely fashion, and that the controller can often cope with a sudden shift of plan. GRA

N93-24313# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

DISTANCE METRIC BETWEEN 3D MODELS AND 2D IMAGES FOR RECOGNITION AND CLASSIFICATION

Ronen Basri and Daphna Weinshall Jul. 1992 35 p

(Contracts N00014-85-K-0124; N00014-91-J-4038)

(AD-A260069; MIT-AIM-1373) Avail: CASI HC A03/MF A01

Similarity measurements between 3D objects and 2D images are useful for the tasks of object recognition and classification. We distinguish between two types of similarity metrics: metrics computed in image-space (image metrics) and metrics computed in transformation-space (transformation metrics). Existing methods typically use image metrics; namely, metrics that measure the difference in the image between the observed image and the nearest view of the object. Example for such a measure is the Euclidean distance between feature points in the image and their corresponding points in the nearest view. (Computing this measure is equivalent to solving the exterior orientation calibration problem.) In this paper we introduce a different type of metrics: transformation metrics. These metrics penalize for the deformations applied to the object to produce the observed image. We present a transformation metric that optimally penalizes for affine deformations under weak-perspective. A closed-form solution, together with the nearest view according to this metric, are derived. The metric is shown to be equivalent to the Euclidean image metric, in the sense that they bound each other from both above and below. For the Euclidean image metric we offer a sub-optimal closed-form solution and an iterative scheme to compute the exact solution. GRA

N93-24331# Sandia National Labs., Albuquerque, NM.

A CAPACITANCE-BASED PROXIMITY SENSOR FOR WHOLE ARM OBSTACLE AVOIDANCE

J. L. Novak and J. T. Feddema 2 Nov. 1992 8 p Presented at the 5th Topical Meeting on Robotics and Remote Systems, Knoxville, TN, 26-29 Apr. 1993

(Contract DE-AC04-76DP-00789)

(DE93-006773; SAND-92-1604C; CONF-930403-14) Avail: CASI HC A02/MF A01

This paper discusses an application of capacitive sensors for detecting incipient collisions during robot motion in unknown or partially modeled environments. Forty-five sensors capable of detecting obstacles up to 330 mm (13 in.) away were distributed over the surface of a PUMA 560 robot arm. Each sensor consisted of a 4 mm thick, 37 mm diameter rings around 21 mm diameter disks. These sensors can detect both conductive and non-conductive obstacles of arbitrary color and shape. The sensor hardware is reliable and inexpensive, and it may be fabricated using flexible printed circuit boards to provide whole-arm and joint protection for any robot or manipulator. Simple collision avoidance control algorithms that perturb the joint commands from a spaceball to avoid collisions have been implemented on the PUMA 560 robot. DOE

N93-24421# California Univ., Los Angeles. Dept. of Computer Science.

NEURAL NET ARCHITECTURE FOR COMPUTING STRUCTURE FROM MOTION Final Report, Jan. 1989 - Jan. 1992

Josef Skrzypek 21 Oct. 1992 8 p

(Contract DAAL03-88-K-0052)

(AD-A260526; ARO-25324.10-MA) Avail: CASI HC A02/MF A01

Analysis of motion contributes to the image understanding tasks by disambiguating scene information whenever the observer and/or objects in

the scene are in motion. This proposal is focused on research and development of algorithms for automatic recalibration from sensory to egocentric coordinates during egomotion. GRA

N93-24503# Tennessee Univ., Knoxville. Dept. of Nuclear Engineering.
NEURAL NETWORKS FOR THE MONITORING OF ROTATING MACHINERY
Israel E. Alguindigue, Anna Loskiewicz-Buczak, and Robert E. Uhrig 1991 13 p Presented at the 8th Power Plant Dynamics, Control and Testing Symposium, Knoxville, TN, 27-29 May 1992
(Contracts DE-FG07-88ER-12824; DE-AC05-84OR-21400)
(DE93-003549; CONF-920538-28) Avail: CASI HC A03/MF A01

Vibration monitoring of components in engineering systems and plants involves the collection of vibration data and detailed analysis to detect features which reflect the operational state of the machinery. The analysis leads to the identification of potential failures and their causes, and makes it possible to perform efficient preventive maintenance. This paper describes a methodology for the automation of some of the activities related to motion and vibration monitoring in these systems. The technique involves training a neural network to model the inter-relationship between signals from two related sensors mounted on an engineering system or component at a time when it is known to be operating properly. Then one signal (or its characteristics) is put into the neural network model to predict the second signal (or its characteristics). This predicted signal is continuously compared with the actual signal. A deviation between the predicted and actual signal indicates a changing relationship, usually failure of the component or system. This deviation may be quantified and provides meaningful information about the degree of degradation and deterioration of the component. DOE

N93-24514# Tennessee Univ., Knoxville. Dept. of Nuclear Engineering.
ANALYSIS OF COMPLEX SYSTEMS USING NEURAL NETWORKS
R. E. Uhrig 1992 6 p Presented at the 2nd International Forum on Expert Systems and Computer Simulation in Energy Engineering, Erlangen, Germany, 17-21 Mar. 1992
(Contract DE-FG07-88ER-12824)
(DE93-003541; CONF-920368-1) Avail: CASI HC A02/MF A01

The application of neural networks, alone or in conjunction with other advanced technologies (expert systems, fuzzy logic, and/or genetic algorithms), to some of the problems of complex engineering systems has the potential to enhance the safety, reliability, and operability of these systems. Typically, the measured variables from the systems are analog variables that must be sampled and normalized to expected peak values before they are introduced into neural networks. Often data must be processed to put it into a form more acceptable to the neural network (e.g., a fast Fourier transformation of the time-series data to produce a spectral plot of the data). Specific applications described include: (1) Diagnostics--State of the Plant, (2) Hybrid System for Transient Identification, (3) Sensor Validation, (4) Plant-Wide Monitoring, (5) Monitoring of Performance and Efficiency, and (6) Analysis of Vibrations. Although specific examples described deal with nuclear power plants or their subsystems, the techniques described can be applied to a wide variety of complex engineering systems. DOE

N93-24564# Brown Univ., Providence, RI. Dept. of Physics.
A NOVEL RECURSIVE PARTITIONING CRITERION Technical Report
Michael P. Perrone 23 Dec. 1992 7 p
(Contract N00014-91-J-1316)
(AD-A259921) Avail: CASI HC A02/MF A01

A data-driven algorithm for partitioning many-class classification problems is presented. The algorithm generates tree-structured hybrid networks with controller nets at tree branches and local expert nets at the leaves. The controller nets recursively partition the feature space according to a novel misclassification minimization rule designed to create groupings of the classes which simplify the classification task. Each local expert is trained only on a subset of the training data corresponding to one of the partitions. The advantage to this approach is that the classification task that each local expert performs is greatly simplified. This simplification helps to avoid the curse of dimensionality and scaling problems by allowing the local expert nets to focus their search for structure in a small portion of the input space. GRA

N93-24599* National Aeronautics and Space Administration. Pasadena Office, CA.
GaAs-BASED OPTOELECTRONIC NEURONS Patent
Steven H. Lin, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), Jae H. Kim, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), and Demetri Psaltis, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 20 Apr. 1993 7 p Filed 3 Mar. 1992
(Contract NAS7-918)
(NASA-Case-NPO-18497-1-CU; US-Patent-5,204,521;
US-Patent-Appl-SN-845283; US-Patent-Class-250-214LS;
US-Patent-Class-307-201; US-Patent-Class-250-551;
Int-Patent-Class-H01J-31/50) Avail: US Patent and Trademark Office

An integrated, optoelectronic, variable thresholding neuron implemented monolithically in GaAs integrated circuit and exhibiting high differential optical gain and low power consumption is presented. Two alternative embodiments each comprise an LED monolithically integrated with a detector and two transistors. One of the transistors is responsive to a bias voltage applied to its gate for varying the threshold of the neuron. One embodiment is implemented as an LED monolithically integrated with a double heterojunction bipolar phototransistor (detector) and two metal semiconductor field effect transistors (MESFET's) on a single GaAs substrate and another embodiment is implemented as an LED monolithically integrated with three MESFET's (one of which is an optical FET detector) on a single GaAs substrate. The first noted embodiment exhibits a differential optical gain of 6 and an optical switching energy of 10 pJ. The second embodiment has a differential optical gain of 80 and an optical switching energy of 38 pJ. Power consumption is 2.4 and 1.8 mW, respectively. Input 'light' power needed to turn on the LED is 2 micro-W and 54 nW, respectively. In both embodiments the detector is in series with a biasing MESFET and saturates the other MESFET upon detecting light above a threshold level. The saturated MESFET turns on the LED. Voltage applied to the biasing MESFET gate controls the threshold.
Official Gazette of the U.S. Patent and Trademark Office

N93-24603*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
RELIABLE VISION-GUIDED GRASPING
Keith E. Nicewarner and Robert B. Kelley Aug. 1992 12 p Previously announced in IAA as A93-29124
(Grant NAGw-1333)
(NASA-CR-193197; NAS 1.26:193197; RPI-CIRSSE-125) Avail: CASI HC A03/MF A01

Automated assembly of truss structures in space requires vision-guided servoing for grasping a strut when its position and orientation are uncertain. This paper presents a methodology for efficient and robust vision-guided robot grasping alignment. The vision-guided grasping problem is related to vision-guided 'docking' problems. It differs from other hand-in-eye visual servoing problems, such as tracking, in that the distance from the target is a relevant servo parameter. The methodology described in this paper is hierarchy of levels in which the vision/robot interface is decreasingly 'intelligent,' and increasingly fast. Speed is achieved primarily by information reduction. This reduction exploits the use of region-of-interest windows in the image plane and feature motion prediction. These reductions invariably require stringent assumptions about the image. Therefore, at a higher level, these assumptions are verified using slower, more reliable methods. This hierarchy provides for robust error recovery in that when a lower-level routine fails, the next-higher routine will be called and so on. A working system is described which visually aligns a robot to grasp a cylindrical strut. The system uses a single camera mounted on the end effector of a robot and requires only crude calibration parameters. The grasping procedure is fast and reliable, with a multi-level error recovery system. Author

N93-24622 Toronto Univ. (Ontario).
ADAPTIVE CONTROL OF UNCERTAIN SYSTEMS Ph.D. Thesis
Daniel E. Miller Toronto, Ontario Univ. of Toronto 1989 199 p
(ISBN-0-315-54485-6; CTN-93-60658) Copyright Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada, HC

The boundaries of what is theoretically achievable using adaptive control are explored in an approach that yields a controller whose parameters are adjusted as time evolves. The plants considered in the study are linear

time-varying, of finite dimension. An operator framework is used to present the results, facilitating a precise definition of the control problems under consideration. Each controller presented consists of a linear time-invariant compensator whose gains switch in accordance with an auxiliary switching signal. In considering the stabilization problem, an adaptive controller is developed which provides a weak asymptotic type of stability for a large class of time-varying plants; from this is developed another controller which provides a stronger exponential type of stability for a slightly smaller class of plants. These results are extended to that of tracking and disturbance regulation in the case where both the reference and the disturbance satisfy known linear time-invariant differential equations. For the model reference adaptive control problem, where the goal is to track a much larger class of signals, it is shown that certain prior plant information is necessary. An adaptive controller is then constructed which solves a modified version of this problem. Author (CISTI)

N93-24640# Norwegian Defence Research Establishment, Kjeller.
SUMMARY FROM A STUDY GROUP ON NEURAL NETWORKS AT NDRE [OPPSUMMERING FRA STUDIEGRUPPEN FOR NEVRALE NETT VED FFI]
Grem S. Gjoennes, Georg Anuglen, Oddbjoern Bergem, Eivind Engebretsen, Hans C. Palm, Ingrid Storruste, and Terje Wahl 3 Jun. 1992 56 p In NORWEGIAN
(FFI-92/7015; ETN-93-93567) Avail: CASI HC A04/MF A01

The findings of an ad hoc study group which were established by NDRE to locate future, promising application areas for the use of neural network technology, are summarized. The arguments are based on either of the following types of information: general insights obtained through ten colloquys on selected topics; a literature survey of existing applications; an overview of existing and future implementation technologies and algorithms; and analyses of NDRE's strategy document and NDRE's program proposal. The conclusions give the following: a broad outline of both the technical and the theoretical status of current neural network technology; a list of a number of applications of particular relevance to NDRE; and recommendations to a course of action for NDRE to possess the necessary knownhow to be an efficient user of neural network technology. ESA

N93-24657*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
VISION-GUIDED GRIPPING OF A CYLINDER
Keith E. Nicewarner and Robert B. Kelley 1991 12 p Presented at the First IARP Workshop on Robotics in Space, Pisa, Italy, 17-18 Jun. 1991
(Grant NAGw-1333)
(NASA-CR-193199; NAS 1.26:193199; RPI-CIRSSE-93) Avail: CASI HC A03/MF A01

The motivation for vision-guided servoing is taken from tasks in automated or telerobotic space assembly and construction. Vision-guided servoing requires the ability to perform rapid pose estimates and provide predictive feature tracking. Monocular information from a gripper-mounted camera is used to servo the gripper to grasp a cylinder. The procedure is divided into recognition and servo phases. The recognition stage verifies the presence of a cylinder in the camera field of view. Then an initial pose estimate is computed and uncluttered scan regions are selected. The servo phase processes only the selected scan regions of the image. Given the knowledge, from the recognition phase, that there is a cylinder in the image and knowing the radius of the cylinder, 4 of the 6 pose parameters can be estimated with minimal computation. The relative motion of the cylinder is obtained by using the current pose and prior pose estimates. The motion information is then used to generate a predictive feature-based trajectory for the path of the gripper. Author

N93-22023# Naval Air Warfare Center, China Lake, CA. Weapons Div.
THE MISSLE-BORNE INTEGRATED NETWORK DEMONSTRATION PROGRAM
M. L. Mumford, D. K. Andes, and L. L. Kern *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 8 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A02/MF A02

N93-22158*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A MACRO-MICRO ROBOT FOR PRECISE FORCE APPLICATIONS
Neville I. Marzwell and Yulun Wang (Computer Motion, Inc., Goleta, CA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 91-100 Sponsored in part by NSF (For primary document see N93-22149 08-99)
(Contract NAS7-1149)
Avail: CASI HC A02/MF A04

N93-22159*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A FAULT-TOLERANT INTELLIGENT ROBOTIC CONTROL SYSTEM
Neville I. Marzwell and Kam Sing Tso (SoHaR, Inc., Beverly Hills, CA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 101-110 (For primary document see N93-22149 08-99)
(Contract NAS7-1172)
Avail: CASI HC A02/MF A04

N93-22161*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ROBOSIM: AN INTELLIGENT SIMULATOR FOR ROBOTIC SYSTEMS
Kenneth R. Fernandez, George E. Cook (Vanderbilt Univ., Nashville, TN.), Csaba Biegl (Vanderbilt Univ., Nashville, TN.), and James F. Springfield (Vanderbilt Univ., Nashville, TN.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 119-125 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22185*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN ARTIFICIAL INTELLIGENCE-BASED STRUCTURAL HEALTH MONITORING SYSTEM FOR AGING AIRCRAFT
Joseph E. Grady, Stanley S. Tang (Structural Integrity Associates, Inc., San Jose, CA.), and K. L. Chen (Structural Integrity Associates, Inc., San Jose, CA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 343-351 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22186*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
REACTIVE CONTROL AND REASONING ASSISTANCE FOR SCIENTIFIC LABORATORY INSTRUMENTS
David E. Thompson, Richard Levinson, and Peter Robinson *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 353-363 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

N93-22187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
KNOWLEDGE FROM PICTURES (KFP)
Walt Truszkowski, Frank Paterra (Computer Technology Associates, Inc., Rockville, MD.), and Sidney Bailin (Computer Technology Associates, Inc., Rockville, MD.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 364-373 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22229*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HYBRID NEURAL NETWORK AND FUZZY LOGIC APPROACHES FOR RENDEZVOUS AND CAPTURE IN SPACE Abstract Only
Hamid R. Berenji and Timothy Castellano *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22285*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
INTELLIGENT SYSTEMS TECHNOLOGY INFRASTRUCTURE FOR INTEGRATED SYSTEMS Abstract Only

Henry Lum, Jr. *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-24389# Italian Space Agency, Rome.
THE STRATEGIC ROLE OF AUTOMATION AND ROBOTICS FOR COLUMBUS UTILIZATION
Simonetta DiPippo *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 291-294 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24391# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Flight Systems Dynamics Inst.
THE SPACE ROBOT TECHNOLOGY EXPERIMENT (ROTEX) ON SPACELAB-MISSION D2
G. Hirzinger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 301-309 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N93-22075# Los Alamos National Lab., NM.
INVERTING SETS AND THE PACKING PROBLEM
Vance Faber, Mark K. Goldberg, Emanuel Knill (Nova Scotia Technical Coll., Halifax.), and Thomas H. Spencer (Nebraska Univ., Omaha.) 1992 16 p Presented at the 7th International Conference on Graph Theory, Combinatorics, Algorithms, and Applications, Kalamazoo, MI, 1-5 Jun. 1992
(Contract W-7405-eng-36)
(DE93-003822; LA-UR-92-3725; CONF-9206317-1) Avail: CASI HC A03/MF A01

Given a set V, a subset S, and a permutation pi of V, we say that pi permutes S if pi(S) intersection S = theta. Given a collection S = (V; S(sub 1)..., S(sub m)), where S(sub i) improper subset V (i = 1,..., m), we say that S is invertible if there is a permutation pi of V such that pi(S(sub i)) improper subset V - S(sub i). We present necessary and sufficient conditions for the invertibility of a collection and construct a polynomial algorithm which determines whether a given collection is invertible. For an arbitrary collection, we give a lower bound for the maximum number of sets that can be inverted. Finally, we consider the problem of constructing a collection of sets such that no sub-collection of size three is invertible. Our constructions of such collections come from solutions to the packing problem with unbounded block sizes. We prove several new lower and upper bounds for the packing problem and present a new explicit construction of packing. DOE

N93-22405# Front Range Scientific Computation, Inc., Denver, CO.
COPPER MOUNTAIN CONFERENCE ON ITERATIVE METHODS, VOLUME 2
1992 380 p Presented at the Copper Mountain Conference on Iterative Methods, Copper Mountain, CO, 9-16 Apr. 1992 Prepared in cooperation with Colorado Univ., Denver, CO
(Contract DE-FG02-91ER-25106)
(DE93-004994; DOE/ER-25106/1-Vol-2; CONF-920472-Vol-2) Avail: CASI HC A17/MF A03

The individual papers contained in this document are indexed separately. The following topics are discussed: multigrid methods; preconditioning; eigenvalue problems; theory of iterative methods; nonsymmetric linear systems; domain decomposition; parallel algorithms; nonlinear systems; software; and student papers. DOE

N93-22527# Sandia National Labs., Albuquerque, NM.
APREPRO: AN ALGEBRAIC PREPROCESSOR FOR PARAMETERIZING FINITE ELEMENT ANALYSES
G. D. Sjaardema Dec. 1992 57 p
(Contract DE-AC04-76DP-00789)
(DE93-006989; SAND-92-2291) Avail: CASI HC A04/MF A01

Aprepro is an algebraic preprocessor that reads a file containing both general text and algebraic, string, or conditional expressions. It interprets the expressions and outputs them to the output file along with the general text. The syntax used in Aprepro is such that all expressions between the delimiters and are evaluated and all other text is simply echoed to the output file. Aprepro contains several mathematical functions, string functions, and flow control constructs. In addition, functions are included that, with some additional files, implement a units conversion system and a material database lookup system. Aprepro was written primarily to simplify the preparation of parameterized input files for finite element analyses at Sandia National Laboratories; however, it can process any text file that does not use the characters. DOE

N93-22664*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A TIME-ACCURATE HIGH-RESOLUTION TVD SCHEME FOR SOLVING THE NAVIER-STOKES EQUATIONS
Hyun Dae Kim and Nan-Suey Liu Dec. 1992 26 p Original contains color illustrations
(RTOP 505-62-52)
(NASA-TM-106056; E-7466; NAS 1.15:106056) Avail: CASI HC A03/MF A01; 4 functional color pages

A total variation diminishing (TVD) scheme has been developed and incorporated into an existing time-accurate high-resolution Navier-Stokes code. The accuracy and the robustness of the resulting solution procedure have been assessed by performing many calculations in four different areas: shock tube flows, regular shock reflection, supersonic boundary layer, and shock boundary layer interactions. These numerical results compare well with corresponding exact solutions or experimental data.
Author (revised)

N93-22672*# Alabama Univ., Huntsville. Dept. of Mathematical Sciences.
ACCURATE COMPUTATION AND CONTINUATION OF HOMOCLINIC AND HETEROCLINIC ORBITS FOR SINGULAR PERTURBATION PROBLEMS Final Report
William W. Vaughan, Mark J. Friedman, and Anand C. Monteiro Washington Mar. 1993 73 p
(Contract NAS8-36955)
(NASA-CR-4503; M-717; NAS 1.26:4503; UAH-5-32341) Avail: CAS! HC A04/MF A01

In earlier papers, Doedel and the authors have developed a numerical method and derived error estimates for the computation of branches of heteroclinic orbits for a system of autonomous ordinary differential equations in R(exp n). The idea of the method is to reduce a boundary value problem on the real line to a boundary value problem on a finite interval by using a local (linear or higher order) approximation of the stable and unstable manifolds. A practical limitation for the computation of homoclinic and heteroclinic orbits has been the difficulty in obtaining starting orbits. Typically these were obtained from a closed form solution or via a homotopy from a known solution. Here we consider extensions of our algorithm which allow us to obtain starting orbits on the continuation branch in a more systematic way as well as make the continuation algorithm more flexible. In applications, we use the continuation software package AUTO in combination with some initial value software. The examples considered include computation of homoclinic orbits in a singular perturbation problem and in a turbulent fluid boundary layer in the wall region problem.
Author (revised)

N93-22759# Argonne National Lab., IL.
THE CANONICAL FORMS OF A LATTICE RULE
J. N. Lyness 1992 15 p Presented at the 4th Numerical Integration Conference, Oberwolfach, Germany, 8-14 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-005686; ANL/MCS/CP-78196; CONF-9211161-1) Avail: CASI HC A03/MF A01

Much of the elementary theory of lattice rules may be presented as an elegant application of classical results. These include Kronecker group representation theorem and the Hermite and Smith normal forms of integer matrices. The theory of the canonical form is a case in point. In this paper, some of this theory is treated in a constructive rather than abstract manner. A step-by-step approach that parallels the group theory is described, leading to an algorithm to obtain a canonical form of a rule of prime power order. The number of possible distinct canonical forms is derived, and this is used to determine the number of integration lattices having specified invariants. DOE

N93-22776# Argonne National Lab., IL. Mathematics and Computer Science Div.

EXTENDING COMPILE-TIME REVERSE MODE AND EXPLOITING PARTIAL SEPARABILITY IN ADIFOR

C. H. Bischof and M. El-Khadiri Oct. 1992 43 p

(Contract W-31-109-eng-38)

(DE93-004668; ANL/MCS-TM-163) Avail: CASI HC A03/MF A01

The numerical methods employed in the solution of many scientific computing problems require the computation of the gradient of a function f:R(sup n) yields R. ADIFOR is a source translator that, given a collection of subroutines to compute f, generates FORTRAN 77 code for computing the derivative of this function. Using the so-called torsion problem from the MINPACK-2 test collection as an example, two issues in automatic differentiation are explored: the efficient computation of derivatives for partial separable functions and the use of the compile-time reverse mode for the generation of derivatives. It is shown that orders of magnitudes of improvement are possible when exploiting partial separability and maximizing use of the reverse mode. DOE

N93-22795# Virginia Univ., Charlottesville. Dept. of Mechanical, Aerospace and Nuclear Engineering.

IMPROVED DETERMINISTIC CALCULATIONAL METHODS FOR IRREGULARLY SHAPED SHIELDS

J. J. Dorning Dec. 1992 41 p

(Contract DE-FG07-88ER-12818)

(DE93-004955; DOE/ER-12818/2; UVA-527390/MANE93/102) Avail: CASI HC A03/MF A01

A new discrete nodal transport method has been developed for general two-dimensional curvilinear geometry by using a boundary-fitted coordinate transformation from the general 'physical' coordinates to square 'computational' coordinates. The metrics which appear in the transformed transport equation are expanded using a simple polynomial function, and the angular divergence term is treated in the same way it is treated in S(sub N) methods for curved geometries. Because the metrics of the transformation depend upon the computational coordinates, the technical details of the formal development of the nodal method differ from those of ordinary nodal methods for rectangular geometry. However, the computational process in the transformed rectangular coordinate system is very similar to that used in conventional discrete nodal transport methods. A discrete S(sub N) method has also been developed to solve the boundary-fitted coordinate transformed transport equation. Simple test problems for non-simple geometries were solved using the zeroth-order nodal method, the first-order nodal method, and the S(sub N) method for the same physical and computational grids. The results for the test problems studied showed that, for most performance criteria, the computational efficiency of the zeroth-order nodal method was the highest of the three methods. DOE

N93-22825*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

LARGE-SCALE COMPUTATION OF INCOMPRESSIBLE VISCOUS FLOW BY LEAST-SQUARES FINITE ELEMENT METHOD

Bo-nan Jiang, T. L. Lin (Livermore Software Technology Corp., CA.), and Louis A. Povinelli Mar. 1993 22 p

(Contract NCC3-233; RTOP 505-62-21)

(NASA-TM-105904; E-7667; NAS 1.15:105904; ICOMP-93-06) Avail: CASI HC A03/MF A01

The least-squares finite element method (LSFEM) based on the velocity-pressure-vorticity formulation is applied to large-scale/three-dimensional steady incompressible Navier-Stokes problems. This method can accommodate equal-order interpolations and results in symmetric, positive definite algebraic system which can be solved effectively by simple iterative methods. The first-order velocity-Bernoulli function-vorticity formulation for incompressible viscous flows is also tested. For three-dimensional cases, an additional compatibility equation, i.e., the divergence of the vorticity vector should be zero, is included to make the first-order system elliptic. The simple substitution of the Newton's method is employed to linearize the partial differential equations, the LSFEM is used to obtain discretized equations, and the system of algebraic equations is solved using the Jacobi preconditioned conjugate gradient method which avoids formation of either element or global matrices (matrix-free) to achieve high efficiency. To show the validity of this scheme for large-scale computation, we give numerical results for 2D driven cavity problem at Re = 10000 with 408 x 400 bilinear elements. The flow in a 3D cavity is calculated at Re = 100, 400, and 1,000 with 50 x 50 x 50 trilinear elements. The Taylor-Goertler-like vortices are observed for Re = 1,000. Author

N93-22829*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE ASYMPTOTIC SPECTRA OF BANDED TOEPLITZ AND QUASI-TOEPLITZ MATRICES

Richard M. Beam and Robert F. Warming Nov. 1991 38 p

(RTOP 505-59-53)

(NASA-TM-103900; A-92006; NAS 1.15:103900) Avail: CASI HC A03/MF A01

Toeplitz matrices occur in many mathematical, as well as, scientific and engineering investigations. This paper considers the spectra of banded Toeplitz and quasi-Toeplitz matrices with emphasis on non-normal matrices of arbitrarily large order and relatively small bandwidth. These are the type of matrices that appear in the investigation of stability and convergence of difference approximations to partial differential equations. Quasi-Toeplitz matrices are the result of non-Dirichlet boundary conditions for the difference approximations. The eigenvalue problem for a banded Toeplitz or quasi-Toeplitz matrix of large order is, in general, analytically intractable and (for non-normal matrices) numerically unreliable. An asymptotic (matrix order approaches infinity) approach partitions the eigenvalue analysis of a quasi-Toeplitz matrix into two parts, namely the analysis for the boundary condition independent spectrum and the analysis for the boundary condition dependent spectrum. The boundary condition independent spectrum is the same as the pure Toeplitz matrix spectrum. Algorithms for computing both parts of the spectrum are presented. Examples are used to demonstrate the utility of the algorithms, to present some interesting spectra, and to point out some of the numerical difficulties encountered when conventional matrix eigenvalue routines are employed for non-normal matrices of large order. The analysis for the Toeplitz spectrum also leads to a diagonal similarity transformation that improves conventional numerical eigenvalue computations. Finally, the algorithm for the asymptotic spectrum is extended to the Toeplitz generalized eigenvalue problem which occurs, for example, in the stability of Pade type difference approximations to differential equations. Author (revised)

N93-22910# Los Alamos National Lab., NM.

MONTE CARLO VARIANCE REDUCTION APPROACHES FOR NON-BOLTZMANN TALLIES

T. E. Booth Dec. 1992 70 p

(Contract W-7405-eng-36)

(DE93-005665; LA-12433) Avail: CASI HC A04/MF A01

Quantities that depend on the collective effects of groups of particles cannot be obtained from the standard Boltzmann transport equation. Monte Carlo estimates of these quantities are called non-Boltzmann tallies and have become increasingly important recently. Standard Monte Carlo variance reduction techniques were designed for tallies based on individual particles rather than groups of particles. Experience with non-Boltzmann tallies and analog Monte Carlo has demonstrated the severe limitations of analog Monte Carlo for many non-Boltzmann tallies. In fact, many calculations absolutely require variance reduction methods to achieve practical computation times. Three different approaches to variance reduction for non-Boltzmann tallies are described and shown to be unbiased. The advantages and disadvantages of each of the approaches are discussed. DOE

N93-22926# Los Alamos National Lab., NM.
A LOCAL EXPONENTIAL TRANSFORM METHOD FOR GLOBAL VARIANCE REDUCTION IN MONTE CARLO TRANSPORT PROBLEMS
R. S. Baker and E. W. Larsen (Michigan Univ., Ann Arbor.) 1992 7 p Presented at the International Topical Meeting on Mathematical Methods and Supercomputing in Nuclear Application (M/C+SNA 1993), Karlsruhe, Germany, 19-23 Apr. 1993
(Contract W-7405-eng-36)
(DE92-018992; LA-UR-92-2349; CONF-930404-1) Avail: CASI HC A02/MF A01

Numerous variance reduction techniques, such as splitting/Russian roulette, weight windows, and the exponential transform exist for improving the efficiency of Monte Carlo transport calculations. Typically, however, these methods, while reducing the variance in the problem area of interest tend to increase the variance in other, presumably less important, regions. As such, these methods tend to be not as effective in Monte Carlo calculations which require the minimization of the variance everywhere. Recently, 'Local' Exponential Transform (LET) methods were developed as a means of approximating the zero-variance solution. A numerical solution to the adjoint diffusion equation is used, along with an exponential representation of the adjoint flux in each cell, to determine 'local' biasing parameters. These parameters are then used to bias the forward Monte Carlo transport calculation in a manner similar to the conventional exponential transform, but such that the transform parameters are now local in space and energy, not global. Results have shown that the Local Exponential Transform often offers a significant improvement over conventional geometry splitting/Russian roulette with weight windows. Since the biasing parameters for the Local Exponential Transform were determined from a low-order solution to the adjoint transport problem, the LET has been applied in problems where it was desirable to minimize the variance in a detector region. The purpose of this paper is to show that by basing the LET method upon a low-order solution to the forward transport problem, one can instead obtain biasing parameters which will minimize the maximum variance in a Monte Carlo transport calculation. DOE

N93-22930# Maryland Univ., College Park. Inst. for Physical Science and Technology.
THE p AND h-p VERSIONS OF THE FINITE ELEMENT METHOD: BASIC PRINCIPLES AND PROPERTIES Technical Note
Ivo Babuska and Manil Suri Sep. 1992 93 p
(Contracts N00014-89-J-1030; F49620-92-J-0100)
(AD-A260237; TN-BN-1139) Avail: CASI HC A05/MF A01

In the classical form of the finite element method, called the h version, piecewise polynomials of fixed degree p are used and the mesh size h is decreased for accuracy. In this paper, the fundamental theoretical ideas behind the relatively recent p-version and h-p version are discussed. In the p-version, a fixed mesh is used and p is allowed to increase. The h-p version combines both approaches. The basic properties and characteristics of these newer versions, especially in areas where their behavior is significantly different from that of the h-version, are described and explained. GRA

N93-22938# Oak Ridge National Lab., TN.
PREDICTING STRUCTURE IN NONSYMMETRIC SPARSE MATRIX FACTORIZATIONS
J. R. Gilbert (Xerox Palo Alto Research Center, CA.) and E. Ng 1991 36 p Presented at the IMA Workshop on Sparse Matrix Computations: Graph Theory Issues and Algorithms, Minneapolis, MN, 14-18 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE93-004119; CONF-9110404-2) Avail: CASI HC A03/MF A01

Many computations on sparse matrices have a phase that predicts the nonzero structure of the output, followed by a phase that actually performs the numerical computation. We study structure prediction for computations that involve nonsymmetric row and column permutations and nonsymmetric or non-square matrices. Our tools are bipartite graphs, matchings, and alternating paths. Our main new result concerns LU factorization with partial pivoting. We show that if a square matrix A has the strong Hall property (i.e., is fully indecomposable) then an upper bound due to George and Ng on the nonzero structure of L + U is as tight as possible. To show this, we prove a crucial result about alternating paths in strong Hall graphs. The alternating-paths theorem seems to be of independent interest: it can also be used to prove related results about structure prediction for QR factorization that are due to Coleman, Edenbrandt, Gilbert, Hare, Johnson, Olesky, Pothen, and van den Driessche. DOE

N93-22965# Oak Ridge National Lab., TN.
A DETAILED STUDY OF NONPERTURBATIVE SOLUTIONS OF TWO-BODY DIRAC EQUATIONS
H. W. Crater, R. L. Becker, C. Y. Wong, and P. VanAlstine Dec. 1992 159 p
(Contract DE-AC05-84OR-21400)
(DE93-004794; ORNL/TM-12122) Avail: CASI HC A08/MF . A02

In quark model calculations of the meson spectrum, fully covariant two-body Dirac equations dictated by Dirac's relativistic constraint mechanics gave a good fit to the entire meson mass spectrum for light quark mesons as well as heavy quark mesons with constituent world scalar and vector potentials depending on just one or two parameters. In this paper, we investigate the properties of these equations that made them work so well by solving them numerically for quantum electrodynamics (QED) and related field theories. The constraint formalism generates a relativistic quantum mechanics defined by two coupled Dirac equations on a sixteen component wave function which contain Lorentz covariant constituent potentials that are initially undetermined. An exact Pauli reduction leads to a second order relativistic Schroedinger-like equation for a reduced eight component wave function determined by an effective interaction--the quasipotential. We first determine perturbatively to lowest order the relativistic quasipotential for the Schroedinger-like equation by comparing that form with one derived from the Bethe-Salpeter equation. Insertion of this perturbative information into the minimal interaction structures of the two-body Dirac equations then completely determines their interaction structures. Then we give a procedure for constructing the full sixteen component solution to our coupled first-order Dirac equations from a solution of the second order equation for the reduced wave function. Next, we show that a perturbative treatment of these equations yields the standard spectral results for QED and related interactions. DOE

N93-23061# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).
COMPLEX PRINCIPAL OSCILLATION PATTERN ANALYSIS
Gerd Buerger Jun. 1992 34 p
(MPIM-86; ETN-93-93447) Avail: CASI HC A03/MF A01

The Complex Principle Oscillation Pattern (CPOP) analysis is introduced as a new tool to resolve regularly evolving patterns from a process of usually high degree of freedom. A characteristic problem in climatological studies is that the involved processes are usually of very high complexity with a large number of degrees of freedom. CPOP is a modification of the conventional POP analysis. The modification results from a critical insight into the theory of linear systems of first order which uncovered problems that arise in the context of standing oscillations. The notion of the traveling rate of a mode is defined and it is demonstrated that the mode's frequency and traveling rate are directly coupled via the system matrix. One consequence is that clean standing oscillations cannot be modeled by linear systems of first order. Similarly to Hamiltonian mechanics the CPOP analysis introduces the conjugate counterpart of a state, which is a kind of momentum, and deals with the new complex state vector 'state + i.momentum'. The method is capable of resolving oscillatory patterns of any given traveling rate from a stationary process. First experiments show that the CPOPs evolve more regularly and with less noise than corresponding POP's. A prediction scheme which is appropriate for CPOP's is defined. With this scheme prediction skills are gained which are significantly stronger than those of the POP model. ESA

N93-23126*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
TIME-STABLE BOUNDARY CONDITIONS FOR FINITE-DIFFERENCE SCHEMES SOLVING HYPERBOLIC SYSTEMS: METHODOLOGY AND APPLICATION TO HIGH-ORDER COMPACT SCHEMES Final Report
Mark H. Carpenter, David Gottlieb (Brown Univ., Providence, RI.), and Saul Abarbanel (Tel-Aviv Univ., Israel.) Washington Mar. 1993 36 p Submitted for publication
(Contracts NAS1-19480; NAS1-18605; RTOP 505-90-52-01)
(NASA-CR-191436; NAS 1.26:191436; ICASE-93-9) Avail: CASI HC A03/MF A01

We present a systematic method for constructing boundary conditions

(numerical and physical) of the required accuracy, for compact (Pade-like) high-order finite-difference schemes for hyperbolic systems. First, a roper summation-by-parts formula is found for the approximate derivative. A 'simultaneous approximation term' (SAT) is then introduced to treat the boundary conditions. This procedure leads to time-stable schemes even in the system case. An explicit construction of the fourth-order compact case is given. Numerical studies are presented to verify the efficacy of the approach. Author

N93-23356# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.

RELATIONSHIPS BETWEEN BANKRUPTCY GAMES AND MINIMUM COST SPANNING TREE GAMES

Theo S. H. Driessen May 1992 21 p

(MEMO-1058; ETN-93-93195) Avail: CASI HC A03/MF A01

The cost allocation problem of setting charges to the users in a given network is considered with the aid of minimum cost spanning trees in the network. In addition, the bankruptcy problem of dividing the estate of the bankrupt concern among the various creditors according to their claims is treated. The aim is to establish that, under certain circumstances, the bankruptcy problem can be seen as a minimum cost spanning tree allocation problem. In the game theoretic setting, the conditions of the estate and the claims which are sufficient and necessary for the repsentation of bankruptcy games as minimum cost spanning tree games are provided. A particular cost allocation rule for the minimum cost spanning tree allocation problem is shown to agree with a certain division rule for the bankruptcy problem. ESA

N93-23374# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.

A COMPARISON OF POLYNOMIAL AND RATIONAL NARMAX MODELS FOR NONLINEAR SYSTEM IDENTIFICATION

Q. M. Zhu and S. A. Billings Jun. 1992 25 p

(Grant SERC-GR/F2417-7)

(RR-444; ETN-93-93490) Avail: CASI HC A03/MF A01

Polynomial and rational expansions of nonlinear stochastic dynamic models are compared. The structure, approximation properties, identifiability properties, and stability of the NARMAX models are discussed and a unified least squared identification algorithms is introduced. Mathematical models for functional approximation and data approximation are considered. Chaotic behavior, bifurcations, and fractals are addressed. The comparison showed that although the rational model often exhibits superior approximation properties, it is much more difficult to identify compared with the polynomial model. ESA

N93-23413*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AN ALGEBRA OF DISCRETE EVENT PROCESSES

Michael Heymann and George Meyer Jun. 1991 75 p

(RTOP 505-66-01)

(NASA-TM-102848; A-90236; NAS 1.15:102848) Avail: CASI HC A04/MF A01

This report deals with an algebraic framework for modeling and control of discrete event processes. The report consists of two parts. The first part is introductory, and consists of a tutorial survey of the theory of concurrency in the spirit of Hoare's CSP, and an examination of the suitability of such an algebraic framework for dealing with various aspects of discrete event control. To this end a new concurrency operator is introduced and it is shown how the resulting framework can be applied. It is further shown that a suitable theory that deals with the new concurrency operator must be developed. In the second part of the report the formal algebra of discrete event control is developed. At the present time the second part of the report is still an incomplete and occasionally tentative working paper. Author

N93-23640# Naval Postgraduate School, Monterey, CA. Dept. of Mathematics.

LEAST SQUARES SURFACE APPROXIMATION TO SCATTERED DATA USING MULTIQUADRIC FUNCTIONS Technical Report, Jan. - Dec. 1992

Richard Franke, Hans Hagen, and Gregory M. Nielson 15 Dec. 1992 31 p

(AD-A259804; NPS-MA-93-008) Avail: CASI HC A03/MF A01

This report documents an investigation into some methods for fitting surfaces to scattered data. The form of the fitting function is a multiquadric function with the criteria for the fit being the least mean squared residual for the data points. The principal problem is the selection of knot points (or base points for the multiquadric basis functions), although the selection of the multiquadric parameter also plays a nontrivial role in the process. We first describe a greedy algorithm for knot selection, and this procedure is used as an initial step in what follows. The minimization including knot locations and multiquadric parameter is explored, with some unexpected results in terms of 'near repeated' knots. This phenomenon is explored, and leads us to consider variable parameter values for the basis functions. Examples and results are given throughout. GRA

N93-23648# National Inst. of Standards and Technology, Gaithersburg, MD. Computing and Applied Mathmatics Lab.

A MECHANISM FOR CAPTURE INTO RESONANCE

T. J. Burns and C. K. R. T. Jones (Brown Univ., Providence, RI.) Jan. 1993 34 p

(Contract N00014-92-J-1401; NSF DMS-91-00085)

(PB93-145761; NISTIR-5104) Avail: CASI HC A03/MF A01

We present a mechanism for capture into resonance in perturbed two-frequency Hamiltonian systems. When an isolated attractor of the averaged system passes through a resonance on a time scale which is asymptotically slower than that on which the damping works, it transfers its domain of attraction to the resonance. GRA

N93-23707# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

RECOGNIZING 3D OBJECTS FOR 2D IMAGES: AN ERROR ANALYSIS

W. E. Grimson, Daniel P. Huttenlocher, and T. D. Alter Jul. 1992 30 p

(Contracts DACA76-85-C-0010; N00014-86-K-0685)

(AD-A260150; AI-M-1362) Avail: CASI HC A03/MF A01

Many recent object recognition systems use a small number of pairings of data and model features to compute the 3D transformation from a model coordinate frame into the sensor coordinate system. In the case of perfect image data, these systems seem to work well. With uncertain image data, however, the performance of such methods is less well understood. In this paper, we examine the effects of two-dimensional sensor uncertainty on the computation of three-dimensional model transformations. We use this analysis to bound the uncertainty in the transformation parameters, as well as the uncertainty associated with applying the transformation to map other model features into the image. We also examine the effects of the transformation uncertainty on the effectiveness of recognition methods. GRA

N93-23713# Maryland Univ., College Park.

NUMERICAL TREATMENT OF VERTEX SINGULARITIES AND INTENSITY FACTORS FOR MIXED BOUNDARY VALUE PROBLEMS FOR THE LAPLACE EQUATION IN R3 Final Report

Ivo Babuska, T. VonPetersdorff, and B. Andersson Oct. 1992 45 p

(Contract N00014-90-J-1030)

(AD-A260107; BN-1140) Avail: CASI HC A03/MF A01

A numerical method for the computation of the singular behavior of the solution of the Laplace equation is proposed. It is shown that the accuracy of the computed stress intensity factor by the h, p, and h-p versions of the finite element method has the same order as the square of the error of the solution measured in the energy norm. Numerical examples are given. GRA

N93-23866# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.

THE SYMMETRY EQUATION PACKAGE FOR REDUCE

Theo vanBemmelen Apr. 1992 74 p

(MEMO-1053; ETN-93-93193) Avail: CASI HC A04/MF A01

The REDUCE package developed for computation of symmetries of partial differential equations using total derivative operators is described. The WEB source code of the implementations of this method for REDUCE is given. Directions of use and an example of a computer session for computation of symmetries for the Korteweg-DeVries equation are included. ESA

N93-24038# Oak Ridge National Lab., TN.
SOLUTION OF THE HELMHOLTZ-POINCARE WAVE EQUATION USING THE COUPLED BOUNDARY INTEGRAL EQUATIONS AND OPTIMAL SURFACE EIGENFUNCTIONS
M. F. Werby (Naval Research Lab., Bay Saint Louis, MS.), M. K. Broadhead (Naval Research Lab., Bay Saint Louis, MS.), M. R. Strayer, and C. Bottcher 1992 8 p Presented at the 7th International Conference on Boundary Element Technology, Albuquerque, NM, 3-5 Jun. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005300; CONF-920664-5) Avail: CASI HC A02/MF A01

The Helmholtz-Poincare Wave Equation (H-PWE) arises in many areas of classical wave scattering theory. In particular it can be found for the cases of acoustical scattering from submerged bounded objects and electromagnetic scattering from objects. The extended boundary integral equations (EBIE) method is derived from considering both the exterior and interior solutions of the H-PWEC's. This coupled set of expressions has the advantage of not only offering a prescription for obtaining a solution for the exterior scattering problem, but it also obviates the problem of irregular values corresponding to fictitious interior eigenvalues. Once the coupled equations are derived, they can be obtained in matrix form by expanding all relevant terms in partial wave expansions, including a bi-orthogonal expansion of the Green's function. However some freedom in the choice of the surface expansion is available since the unknown surface quantities may be expanded in a variety of ways so long as closure is obtained. Out of many possible choices, we develop an optimal method to obtain such expansions which is based on the optimum eigenfunctions related to the surface of the object. In effect, we convert part of the problem (that associated with the Fredholms integral equation of the first kind) an eigenvalue problem of a related Hermitian operator. The methodology will be explained in detail and examples will be presented. DOE

N93-24055# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
CONVERGENCE RATES OF APPROXIMATION BY TRANSLATES
Federico Girosi and Gabriele Anzellotti Feb. 1992 18 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124)
(AD-A260100; AI-M-1288) Avail: CASI HC A03/MF A01

In this paper we consider the problem of approximating a function belonging to some function space by a linear combination of n translates of a given function G. Using a lemma by Jones (1990) and Barron (1991) we show that it is possible to define function spaces and functions G for which the rate of convergence to zero of the error is in any number of dimensions. The apparent avoidance of the curse of dimensionality is due to the fact that these function spaces are more and more constrained as the dimension increases. Examples include spaces of the Sobolev type, in which the number of weak derivatives is required to be larger than the number of dimensions. We give results both for approximation in the L2 norm and in the L(infinity) norm. The interesting feature of these results is that, thanks to the constructive nature of Jones' and Barron's lemma, an iterative procedure is defined that can achieve this rate. GRA

N93-24056# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
PROJECTIVE STRUCTURE FROM TWO UNCALIBRATED IMAGES: STRUCTURE FROM MOTION AND RECOGNITION
Amnon Shashua Sep. 1992 21 p
(Contract N00014-85-K-0124; NSF IRI-89-00267)
(AD-A260102; AI-M-1363) Avail: CASI HC A03/MF A01

This paper addresses the problem of recovering relative structure, in the form of an invariant, from two views of a 3D scene. The invariant structure is computed without any prior knowledge of camera geometry, or internal calibration, and with the property that perspective and orthographic projections are treated alike, namely, the system makes no assumption regarding the existence of perspective distortions in the input images. We show that, given the location of epipoles, the projective structure invariant can be constructed from only four corresponding points projected from four non-coplanar points in space (like in the case of parallel projection). This result leads to two algorithms for computing projective structure. The first algorithm requires six corresponding points, four of which are assumed to be projected from four coplanar points in space. Alternatively, the second algorithm requires eight corresponding points, without assumptions of coplanarity of object points. Our study of projective structure is applicable to both structure from motion and visual recognition. We use projective structure to re-project the 3D scene from two model images and six or eight corresponding points with a novel view of the scene. The re-projection process is well-defined under all cases of central projection, including the case of parallel projection. GRA

N93-24064# Naval Postgraduate School, Monterey, CA. Dept. of Operations Research.
BAYESIAN PREDICTION OF MEAN SQUARE ERRORS WITH COVARIATES
Donald P. Gaver and Patricia A. Jacobs Nov. 1992 37 p
(AD-A259585; NPSOR-93-004) Avail: CASI HC A03/MF A01

Estimation of mean square prediction error of wind components is required in the optimal interpolation (OI) process in numerical prediction of atmospheric variables. Previous work has suggested that statistical models with log-linear scale parameters which include covariates can be used to predict mean square prediction errors. However, the parameters of the statistical relationships appear to change over time. A procedure is described to recursively update the estimated parameters. Data from July of 1991 are used to fit the model parameters and to study the predictive ability of the recursive procedure. This preliminary investigation indicates that observational and first guess wind components can be helpful in predicting mean square prediction error for wind components. GRA

N93-24109# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
COVERINGS AND NONLOCAL SYMMETRIES
Theo vanBemmelen May 1992 15 p
(MEMO-1057; ETN-93-93194) Avail: CASI HC A03/MF A01

The introduction of potential symmetries, that is special nonlocal symmetries by Bliman, Reid and Kumei, is discussed. The concept of a nonlocal symmetry is aesthetically justified by the theory of coverings. The basic idea is that solutions of the covering system imply solutions of the covered system. Bluman, Kumei and Reid never considered the symmetries lost, that is local symmetries of the covered system that do not extend to local symmetries of the covering system. Examples of coverings that regain these lost symmetries, demonstrating the more natural setting of coverings, are given. ESA

N93-24169# Massachusetts Univ., Amherst. Dept. of Mathematics and Statistics.
AN ANALYTICAL STUDY OF SOME PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS TO FLUID DYNAMICS AND WAVE PROPAGATION Final Report, 1 Nov. 1989 - 31 Oct. 1992
George H. Knightly 31 Oct. 1992 4 p
(Contract N00014-90-J-1031)
(AD-A260351) Avail: CASI HC A01/MF A01

Much of the research effort during the grant period was devoted to investigations of periodic waves and stability in fluid dynamics. Progress was also made on marching schemes in acoustic wavepropagation. In the area of fluid dynamics, problems relating to spiral flows of a viscous incompressible fluid between concentric cylinders in the narrow gap limit were investigated. When the motion of the fluid is driven by rotating and sliding of the cylinders, the problem is that of rotating, plane, Couette flow; when an axial pressure gradient is added, rotating, plane, Couette-Poiseuille flow ensues. Various such problems for viscous, incompressible flow lead to abstract equations in a Banach space B. GRA

N93-24245# Cognitech, Inc., Santa Monica, CA.
FEATURE-ORIENTED SIGNAL PROCESSING UNDER NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS Final Report, 1 Nov. 1989 - 31 Oct. 1992
Stanley Osher and Leonid Rudin 1992 33 p
(Contract F49620-90-C-0011)
(AD-A259951; AFOSR-93-0023TR) Avail: CASI HC A03/MF A01

A successful nonlinear partial differential equation based approach to restoration was carried out. ENO least squares, shock filters, feature detectors and total variation based deconvolution techniques were combined.

Also rigorous morphological methods and wavelet analysis were developed and used to restore noisy, blurry images. GRA

N93-24411# Worcester Polytechnic Inst., MA.
CENTER FOR SHAPE OPTIMIZATION AND MATERIAL LAYOUT Final Report, 1 Jun. 1990 - 31 Oct. 1992
Konstantin A. Lurie and James I. Northrup 1992 233 p
(Grant AF-AFOSR-0268-90)
(AD-A260087; AFOSR-93-0009TR) Avail: CASI HC A11/MF A03

The final report reflects the development of a direct method of solving problems of optimal design of systems described by elliptic equations of the 2nd and 4th order. This method is based on a special 'polysaddle' transformation of the integrand of the corresponding max min - problem applied to construct the appropriate two-sided bounds; an analytical and computational technique is developed to make this construction possible. Geometrical aspects of the above transform are discussed in detail as well as the material implementation of the corresponding layouts. The results obtained provide a theoretical basis for a direct computational assembling of the global layout from special laminar microstructures determined analytically by the aforementioned technique. GRA

N93-24415# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
ANALYTICAL REPRESENTATION OF CONTOURS
Ronald D. Chaney Oct. 1992 46 p
(Contract N00014-91-J-0438)
(AD-A260151; AI-M-1392) Avail: CASI HC A03/MF A01

The interpretation and recognition of noisy contours, such as silhouettes, have proven to be difficult. One obstacle to the solution of these problems has been the lack of a robust representation for contours. In this paper, we present an analytical representation for contours. The contour is represented by a set of pairwise tangent circular arcs. The advantage of such an approach is that mathematical properties such as orientation and curvature are explicitly represented. We introduce a smoothing criterion for the contour that optimizes the tradeoff between the complexity of the contour and proximity of the data points. The complexity measure is the number of extrema of curvature present in the contour. The smoothing criterion leads us to a true scale-space for contours. We describe the computation of the contour representation as well as the computation of relevant properties of the contour. We consider the potential application of the representation, the smoothing paradigm, and the scale-space to contour interpretation and recognition. GRA

N93-24437# Maryland Univ., College Park. Inst. for Physical Science and Technology.
A PRIORI ERROR ESTIMATES OF FINITE ELEMENT SOLUTIONS OF PARAMETRIZED NONLINEAR EQUATIONS Final Report
Takuya Tsuchiya and Ivo Babuska Nov. 1992 33 p
(Contract N00014-90-J-1030; NSF CCR-88-20279)
(AD-A260013; BN-1142) Avail: CASI HC A03/MF A01

In this paper, a priori error estimates of finite element solutions of second order parametrized strongly nonlinear equations in divergence form on one-dimensional bounded intervals are studied. The Banach space is chosen in formulation of the error analysis so that the nonlinear differential operators defined by the differential equations are nonlinear Fredholm operators of index 1. Finite element solutions are defined in a natural way, and several a priori estimates are proved on regular branches and on branches around turning points. GRA

N93-24438# Maryland Univ., College Park. Inst. for Physical Science and Technology.
A POSTERIORI ERROR ESTIMATES OF FINITE ELEMENT SOLUTIONS OF PARAMETRIZED NONLINEAR EQUATIONS Final Report
Takuya Tsuchiya and Ivo Babuska Nov. 1992 35 p
(Contract N00014-90-J-1030; NSF CCR-88-20279)
(AD-A260014; BN-1143) Avail: CASI HC A03/MF A01

Nonlinear differential equations with parameters are called parametrized nonlinear equations. This paper studies a posteriori error estimates of finite element solutions of second order parametrized strongly nonlinear equations in divergence form on one-dimensional bounded intervals. In the previous paper by the authors, the finite element solutions are defined, and several a priori estimates are proved on regular branches and on branches around turning points. Using obtained a priori error estimates, we obtain several practical a posteriori error estimates which are asymptotically exact. Some numerical examples are given. GRA

N93-24492*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON ESSENTIALLY NON-OSCILLATORY SCHEMES ON UNSTRUCTURED MESHES: ANALYSIS AND IMPLEMENTATION Final Report
R. Abgrall (Institut National de Recherche d'Informatique et d'Automatique, Valbonne, France.) Washington Dec. 1992 38 p Submitted for publication Sponsored by NASA. Langley Research Center
(Contract NAS1-19480; RTOP 505-90-52-01)
(NASA-CR-191415; NAS 1.26:191415; ICASE-92-74; AD-A261844) Avail: CASI HC A03/MF A01

A few years ago, the class of Essentially Non-Oscillatory Schemes for the numerical simulation of hyperbolic equations and systems was constructed. Since then, some extensions have been made to multidimensional simulations of compressible flows, mainly in the context of very regular structured meshes. In this paper, we first recall and improve the results of an earlier paper about non-oscillatory reconstruction on unstructured meshes, emphasizing the effective calculation of the reconstruction. Then we describe a class of numerical schemes on unstructured meshes and give some applications for its third order version. This demonstrates that a higher order of accuracy is indeed obtained, even on very irregular meshes. Author

N93-24574# Mound Lab., Miamisburg, OH.
COMPARISON OF OPERATIONAL AND STANDARD METHODS FOR DATA IN RECTANGULAR ARRAY
G. L. Silver 18 Feb. 1993 28 p
(Contract DE-AC04-88DP-43495)
(DE93-007783; MLM-3773) Avail: CASI HC A03/MF A01

The standard four-point and nine-point methods for interpolating data in rectangular array are compared to operational four-point and nine-point methods. The operational methods usually fit surfaces better than the standard methods. For functions that are continuous, change slowly over the region of interest, and do not contain extrema, one of the operational methods yields reasonable approximations to the coefficients obtained by the least squares method. DOE

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N93-22061# Argonne National Lab., IL.
BIASES IN MONTE CARLO EIGENVALUE CALCULATIONS
E. M. Gelbard 1992 13 p Presented at the International Association Mathematics and Computers Simulation International Symposium on Mathematical Modelling and Computer Simulation, Bangalore, India, 7-11 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-004189; ANL/CP-75373; CONF-921209-3) Avail: CASI HC A03/MF A01

The Monte Carlo method has been used for many years to analyze the neutronics of nuclear reactors. In fact, as the power of computers has increased the importance of Monte Carlo in neutronics has also increased, and today, this method plays a central role in reactor analysis and design. Monte Carlo is used in neutronics for two somewhat different purposes: (1) to compute the distribution of neutrons in a given medium when the neutron source-density is specified; and (2) to compute the neutron distribution in a self-sustaining chain reaction, in which case the source is determined as the eigenvector of a certain linear operator. In (2), then, the source is not given, but must be computed. In the first case (the 'fixed-source' case) the Monte Carlo calculation is unbiased. That is to say that, if the calculation is repeated ('replicated') over and over, with independent random number sequences for each replica, then averages over all replicas will approach the correct neutron distribution as the number of replicas goes to infinity. Unfortunately, the computation is not unbiased in the second case, which we discuss here. DOE

N93-22593# Brookhaven National Lab., Upton, NY.
ON THE PRIOR PROBABILITIES FOR TWO-STAGE BAYESIAN ESTIMATES
P. Kohut 1992 5 p Presented at the Probabilistic Safety Assessment International Topical Meeting (PSA 93), Clearwater Beach, FL, 27-29 Jan. 1993
(Contract DE-AC02-76CH-00016)
(DE93-006389; BNL-NUREG-48226; CONF-930116-35) Avail: CASI HC A01/MF A01

The method of Bayesian inference is reexamined for its applicability and for the required underlying assumptions in obtaining and using prior probability estimates. Two different approaches are suggested to determine the first-stage priors in the two-stage Bayesian analysis which avoid certain assumptions required for other techniques. In the first scheme, the prior is obtained through a true frequency based distribution generated at selected intervals utilizing actual sampling of the failure rate distributions. The population variability distribution is generated as the weighed average of the frequency distributions. The second method is based on a non-parametric Bayesian approach using the Maximum Entropy Principle. Specific features such as integral properties or selected parameters of prior distributions may be obtained with minimal assumptions. It is indicated how various quantiles may also be generated with a least square technique. DOE

N93-22670*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
IMPROVING THE CHI-SQUARED APPROXIMATION FOR BIVARIATE NORMAL TOLERANCE REGIONS
Alan H. Feiveson Washington Mar. 1993 9 p
(NASA-TP-3304; S-698; NAS 1.60:3304) Avail: CASI HC A02/MF A01

Let X be a two-dimensional random variable distributed according to N2(mu,Sigma) and let bar-X and S be the respective sample mean and covariance matrix calculated from N observations of X. Given a containment probability beta and a level of confidence gamma, we seek a number c, depending only on N, beta, and gamma such that the ellipsoid R = (x: (x - bar-X)'S(exp -1) (x - bar-X) less than or = c) is a tolerance region of content beta and level gamma; i.e., R has probability gamma of containing at least 100 beta percent of the distribution of X. Various approximations for c exist in the literature, but one of the simplest to compute -- a multiple of the ratio of certain chi-squared percentage points -- is badly biased for small N. For the bivariate normal case, most of the bias can be removed by simple adjustment using a factor A which depends on beta and gamma. This paper provides values of A for various beta and gamma so that the simple approximation for c can be made viable for any reasonable sample size. The methodology provides an illustrative example of how a combination of Monte-Carlo simulation and simple regression modelling can be used to improve an existing approximation. Author (revised)

N93-23375# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
IDENTIFICATION OF SYSTEMS FROM NON-UNIFORMLY SAMPLED DATA
K. M. Tsang (Hong Kong Polytechnic, Kowloon.) and S. A. Billings May 1992 24 p
(RR-452; ETN-93-93493) Avail: CASI HC A03/MF A01

The identification of continuous time models from uniformly sampled data records is investigated and an identification algorithm based on the state variable filter approach is derived. The orthogonal least squares estimator is shown to be adaptable for the identification of continuous time models from nonuniformly sampled data records and instrumental variables are introduced to reduce the bias on stochastic system identification. Multiplying the filtered variables obtained from the state variable filter with higher powers of the noise free output signal prior to the estimation is shown to enhance the parameter estimates. Simulated examples are concluded to illustrate the methods. ESA

N93-23460# Texas A&M Univ., College Station. Research Foundation.
CHANGE PP PLOT AND CONTINUOUS SAMPLE QUANTILE FUNCTION
Emanuel Parzen Oct. 1992 20 p
(Contract DAAL03-90-G-0069)
(AD-A259833; TR-189) Avail: CASI HC A03/MF A01

Functional inference recommends data analysis of a sample of n observations by functional and graphical representations of its probability models using various functions on 0 less than u less than 1, including the quantile function. This paper discusses: change PP plots and a continuous version of the sample quantile function which use the mid-distinct values probability integral transform; comparison density functions; comparison interpretation of probability integral transform; maximum spacings method of one sample parameter estimation. GRA

N93-23655# Kaman Sciences Corp., Colorado Springs, CO.
THE MEANING AND UTILITY OF CONFIDENCE Technical Report, 1 Jan. - 30 Apr. 1992
R. L. Williams and Wilson Y. Gateley 1 Nov. 1992 80 p
(Contract DNA001-89-C-0080)
(AD-A259646; K92-6U(R); DNA-TR-92-83) Avail: CASI HC A05/MF A01

This report presents an approach to establishing point estimates of system survivability along with associated confidence levels. It applies this approach to an example problem. The report also contains a probability tutorial. GRA

N93-23711# Stanford Univ., CA.
TOPICS IN STOCHASTIC SYSTEMS, FAILURE TIME MODELS CHANGE-POINT PROBLEMS, AND SEQUENTIAL ANALYSIS Final Report, 1 Jun. 1989 - 31 May 1992
David Siegmund 7 Dec. 1992 5 p
(Grant AF-AFOSR-0355-89)
(AD-A260047; AFOSR-93-0010TR) Avail: CASI HC A01/MF A01

Fundamental progress was made in the sequential and fixed sample detection and estimation of abrupt changes in stochastic systems and in the related problem of adaptive control of dynamical systems with time varying parameters. Also studied were recursive estimation and adaptive control of linear stochastic systems, where an essentially complete asymptotic solution was developed for the problem of adaptive estimation of inputs to keep the output of a system close to a fixed target. Advances were made in regression analysis of censored failure time data, inference in nonlinear regression models, and sequential analysis. Related probability theory involving boundary crossing problems and approximate distributions of maxima of random fields was developed. GRA

N93-23864# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
VALIDATION OF DISTRIBUTED SYSTEMS BY FAULT INJECTION Ph.D. Thesis - Ecole Nationale Superieure de l'Aeronautique et de l'Espace [VALIDATION DE SYSTEMES REPARTIS PAR INJECTION DE FAUTES]
Eliane Martins 1992 155 p In FRENCH; ENGLISH summary
(LAAS-92180; ETN-93-93687) Avail: CASI HC A08/MF A02

Theoretical and practical results concerning the validation of fault tolerant distributed systems using physical fault injection are presented. A test method is proposed that integrates both goals of validation (verification and evaluation), involving the following aspects: definition of a distributed test architecture that supports physical fault injection; selection of test sequences considering faults as an additional test input; determination of whether the observed service satisfies the specified properties; and estimation of the coverage of the fault tolerance mechanisms based on readouts collected during the experiments. To obtain good quality estimations while reducing time and effort of test realization, sampling methods are applied. In particular, the 'missing values' problem (nonsignificant experiments) is tackled by the use of an a posteriori stratification technique, based on groups of equipotential lines affected by the tests. This method was applied during the validation of an open dependable distributed architecture. The results obtained illustrate the important contribution of physical fault injection in the validation of fault tolerant systems. ESA

N93-24114# Florida State Univ., Tallahassee.
TRANSFORMATIONS OF GAUSSIAN RANDOM FIELDS AND A TEST FOR INDEPENDENCE OF A SURVIVAL TIME FROM A COVARIATE
Ian W. McKeague, A. M. Nikabadze, and Yanqing Sun Nov. 1992 29 p
(Contract DAAL03-90-G-0103; AF-AFOSR-0048-91)
(AD-A260442; FSU-TR-M-879; OSARO-TR-D-130; ARO-27868.24-MA)
Avail: CASI HC A03/MF A01

It has been almost sixty years since Kolmogorov introduced a distribution-free omnibus test for the simple null hypothesis that a distribution function coincides with a given distribution function. Doob subsequently

observed that Kolmogorov's approach could be simplified by transforming the empirical process to an empirical process based on uniform random variables. Recent use of more sophisticated transformations has led to the construction of asymptotically distribution-free omnibus tests when unknown parameters are present. The transformation approach is used to construct an asymptotically distribution-free omnibus test for independence of a survival time from a covariate. The test statistic is obtained from a certain test statistic process (indexed by time and covariate), which is shown to converge in distribution to a Brownian sheet. A simulation study is carried out to investigate the finite sample properties of the proposed test and an application to data from the British Medical Research Council's 4th myelomatosis trial is given. GRA

N93-24248# Pennsylvania Univ., Philadelphia.
PROBABILITY AND STATISTICS APPLIED TO THE THEORY OF ALGORITHMS Final Report, 1 May 1991 - 31 May 1992
J. M. Steele Dec. 1992 14 p
(Grant AF-AFOSR-0259-91)
(AD-A259956; AFOSR-93-0015TR) Avail: CASI HC A03/MF A01

This grant has the central aim of exploring when, and how, probability is useful in the theory of algorithms. Most of the problems reviewed have their origins in the area of Euclidean Combinatorial Optimization, which might be operationally defined as the theory that has evolved out of the study Euclidean traveling salesman problem (TSP), the minimal spanning tree problem, and the minimal matching problem. Probability enters the study of such problems by two different paths. One path calls on exogenous randomization in the course of a genuine probabilistic algorithm. This path is of increasing importance in many areas, and on an elementary level is well illustrated by the method of simulated annealing. A second path of considerable importance calls on the introduction of stochastic models for the problem inputs. One then uses probability theory to understand as deeply as possible the behavior of the associated objective functions. This understanding is used subsequently to guide algorithm design. GRA

N93-24317# North Carolina Univ., Chapel Hill. Dept. of Statistics.
RESEARCH IN STOCHASTIC PROCESSES AND THEIR APPLICATIONS
Stamatis Cambanis, Gopinath Kallianpur, and M. R. Leadbetter Jan. 1993 54 p
(Contract DAAL03-92-G-0008)
(AD-A260174; ARO-29297.1-MA) Avail: CASI HC A04/MF A01

Research was conducted and directed in the area of stochastic processes and their applications in engineering, neurophysiology and oceanography: stochastic differential equations in infinite dimensional spaces; stochastic differential equation models for spatially distributed neurons; propagation of chaos for interacting systems; nonlinear white noise analysis; sampling designs for time series; wavelets, multiresolution decomposition, and random processes; non-Gaussian stable models--structure and inference; inference for linear and harmonizable time series; periodically correlated and other nonstationary processes; sample function properties; random fields and their prediction; Markov random field models for vision; point processes, random sets, and random measures; random measures associated with high levels; and tail inference for stationary sequences. GRA

N93-24457 Texas Univ., Austin.
STOCHASTIC INFLATION AND INFLATIONARY DENSITY FLUCTUATIONS Ph.D. Thesis
In Su Yi 1992 308 p
Avail: Univ. Microfilms Order No. DA9239380

We examine the stochastic dynamics of chaotic inflation. The non-linear stochastic behavior of inflation is studied with an emphasis on possible non-Gaussian statistics in initial conditions for cosmological large scale structure formation. Large scale non-random phase correlations and interesting dynamical features are analyzed using stochastic dynamics. We solve the stochastic evolution equations for the inflation field during the slow-roll period of chaotic inflation. We find exact analytic solutions for the quartic potential. Although the resulting statistics of the scalar field fluctuations are non-Gaussian, the current cosmic microwave constraint on the strength of the self-coupling for adiabatic fluctuations makes non-Gaussian effects negligibly small. Coarse-grained (long wavelength) scaler fields in stochastic dynamics become nonlinear stochastic variables whose stochastic random evolution is derived from generation and addition of short wave-length quantum noises. The interplay between the classical roll-down and quantum fluctuations makes the evolution of the scaler fields nonclassical. Only during the very late stage of inflation do the fields acquire their classical interpretation. The statistics of initial conditions for cosmological density fluctuations depend on the details of scalar field dynamics during inflation. We point out that initial conditions for large scale structure in inflationary scenarios with the simplest models are Gaussian to a high precision. However, as we consider more finely tuned models of inflation designed to yield special power spectra, Gaussian initial conditions should not be taken for granted, even on astrophysically interesting scales. We use stochastic dynamics to examine the probability of successful inflation from various initial conditions at the Planck epoch. The slow-roll stochastic framework is extended to nonslow-roll evolution. The well-known classical slow-roll attractors exist even when large quantum fluctuations are included. However, a significant fraction of the initial condition phase space which leads to a successful inflationary stage in the classical analysis fails to inflate. Dissert. Abstr.

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N93-22559*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DYNAMIC ANALYSIS OF FREE-PISTON STIRLING ENGINE/LINEAR ALTERNATOR-LOAD SYSTEM-EXPERIMENTALLY VALIDATED
M. David Kankam, Jeffrey S. Rauch (Sverdrup Technology, Inc., Brook Park, OH.), and Walter Santiago Aug. 1992 11 p Presented at the 27th Intersociety Energy Conversion Engineering Conference, San Diego, CA, 3-7 Aug. 1992; sponsored by ANS, SAE, ASC, AIAA, IEEE, and AIChE
(RTOP 590-13-11)
(NASA-TM-106034; E-7017; NAS 1.15:106034) Avail: CASI HC A03/MF A01

This paper discusses the effects of variations in system parameters on the dynamic behavior of the Free-Piston Stirling Engine/Linear Alternator (FPSE/LA)-load system. The mathematical formulations incorporate both the mechanical and thermodynamic properties of the FPSE, as well as the electrical equations of the connected load. A state-space technique in the frequency domain is applied to the resulting system of equations to facilitate the evaluation of parametric impacts on the system dynamic stability. Also included is a discussion on the system transient stability as affected by sudden changes in some key operating conditions. Some representative results are correlated with experimental data to verify the model and analytic formulation accuracies. Guidelines are given for ranges of the system parameters which will ensure an overall stable operation. Author

N93-22878*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
WELL-POSEDNESS OF A MODEL FOR STRUCTURAL ACOUSTIC COUPLING IN A CAVITY ENCLOSED BY A THIN CYLINDRICAL SHELL Final Report
H. T. Banks (North Carolina State Univ., Raleigh.) and R. C. Smith Washington Mar. 1993 23 p Submitted for publication
(Contracts NAS1-18605; NAS1-19480; AF-AFOSR-0091-90; RTOP 505-90-52-01)
(NASA-CR-191439; NAS 1.26:191439; ICASE-93-10) Avail: CASI HC A03/MF A01

A fully coupled mathematical model describing the interactions between a vibrating thin cylindrical shell and enclosed acoustic field is presented. Because the model will ultimately be used in control applications involving piezoceramic actuators, the loads and material contributions resulting from piezoceramic patches bonded to the shell are included in the discussion. Theoretical and computational issues lead to the consideration of a weak form of the modeling set of partial differential equations (PDE's) and through the use of a semigroup formulation, well-posedness results for the system model are obtained. Author

N93-23016*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MODELLING A SINGLE PHASE VOLTAGE CONTROLLED RECTIFIER USING LAPLACE TRANSFORMS
L. Alan Kraft (Valparaiso Univ., IN.) and M. David Kankam Sep. 1992 8 p Presented at the 5th International Conference on Harmonics in Power Systems, Atlanta, GA, 22-25 Sep. 1992; sponsored by IEEE
(RTOP 506-41-41)
(NASA-TM-106005; E-7552; NAS 1.15:106005) Avail: CASI HC A02/MF A01

The development of a 20 kHz, AC power system by NASA for large space projects has spurred a need to develop models for the equipment which will be used on these single phase systems. To date, models for the AC source (i.e., inverters) have been developed. It is the intent of this paper to develop a method to model the single phase voltage controlled rectifiers which will be attached to the AC power grid as an interface for connected loads. A modified version of EPRI's HARMFLO program is used as the shell for these models. The results obtained from the model developed in this paper are quite adequate for the analysis of problems such as voltage resonance. The unique technique presented in this paper uses the Laplace transforms to determine the harmonic content of the load current of the rectifier rather than a curve fitting technique. Laplace transforms yield the coefficient of the differential equations which model the line current to the rectifier directly. Author

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N93-22919# Los Alamos National Lab., NM.
REVIEW OF QUANTUM COMPUTATION
S. Lloyd 1992 7 p Presented at the International Symposium on Quantum Physics in the Universe, Tokyo, Japan, 19-23 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003735; LA-UR-92-3339; CONF-9208189-1) Avail: CASI HC A02/MF A01

Digital computers are machines that can be programmed to perform logical and arithmetical operations. Contemporary digital computers are 'universal,' in the sense that a program that runs on one computer can, if properly compiled, run on any other computer that has access to enough memory space and time. Any one universal computer can simulate the operation of any other, and the set of tasks that any such machine can perform is common to all universal machines. Since Bennett's discovery that computation can be carried out in a non-dissipative fashion, a number of Hamiltonian quantum-mechanical systems have been proposed whose time-evolutions over discrete intervals are equivalent to those of specific universal computers. The first quantum-mechanical treatment of computers was given by Benioff, who exhibited a Hamiltonian system with a basis whose members corresponded to the logical states of a Turing machine. In order to make the Hamiltonian local, in the sense that its structure depended only on the part of the computation being performed at that time, Benioff found it necessary to make the Hamiltonian time-dependent. Feynman discovered a way to make the computational Hamiltonian both local and time-independent by incorporating the direction of computation in the initial condition. In Feynman's quantum computer, the program is a carefully prepared wave packet that propagates through different computational states. Deutsch presented a quantum computer that exploits the possibility of existing in a superposition of computational states to perform tasks that a classical computer cannot, such as generating purely random numbers, and carrying out superpositions of computations as a method of parallel processing. In this paper, we show that such computers, by virtue of their common function, possess a common form for their quantum dynamics. DOE

N93-23692# Oak Ridge National Lab., TN.
SOLUTION OF A CLASS OF STURM-LIOUVILLE PROBLEMS USING THE GALERKIN METHOD WITH GLOBAL BASIS FUNCTIONS
C. Bottcher, M. R. Strayer, and M. F. Werby (National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.) 1992 7 p Presented at the 7th International Conference on Boundary Element Technology, Albuquerque, NM, 3-5 Jun. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005156; CONF-920664-4) Avail: CASI HC A02/MF A01

Many problems in physics and engineering can be reduced to the Sturm-Liouville (S-L) Problem. For some classes of the S-L problem we develop a method that can rapidly result in computational solutions. Let us assume that we can write the problem as follows: d(sup 2)U(sub i)r/dr(sup 2) + (K(r) - gamma(sub i))U(sub i)r = 0 where L is an eigenvalue and K(r) is some well behaved (i.e. positive definite) function of r. Now let k correspond to some average value of K(r) over the domain of K(r). The boundary conditions are general. Then we easily solve the following problem: d(sup 2)psi(sub i)(r)/dr(sup 2) + (k - gamma(sub i))psi(sub i)(r) = 0. This yields global basis functions. We determine an efficient method to obtain solutions of the form: U(sub i) = Sigma(sub i=1)(sup N)a(sub ij)psi(sub j) in which we determine the best expansion coefficients a(sub ij) as well as the eigenvalues L(sub i)'s in terms of the 1(sub i)'s and the a(sub ij)'s. We also develop several perturbation methods from the technique. The method is then applied to typical problems found in acoustics and quantum mechanics. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N93-22047# California Univ., Berkeley. Lawrence Berkeley Lab.
REDUCED MASS PERSISTENT SWITCHES FOR LARGE SUPERCONDUCTING MAGNETS IN SPACE
M. A. Green Aug. 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004782; LBL-32979; CONF-920802-44) Avail: CASI HC A01/MF A01

Superconducting magnets in space must operate in the persistent mode. The characteristics of low mass niobium titanium persistent switches for low mass superconducting magnets which are designed to quench protect themselves through the quench back process are described. (The whole coil is driven normal shortly after the quench has started and the magnet stored energy is taken up by the coil and the persistent switch.) The concept of using a resistor and diode in parallel with the persistent switch to reduce the overall mass of the persistent switch system and the helium consumption during magnet charging is discussed. A 1.4 meter diameter free-flyer version of the 11.6 MJ stored energy ASTROMAG magnet and its persistent switch is presented as an example. DOE

N93-22080# Science Applications International Corp., McLean, VA.
CHINESE RESEARCH ON SHOCK PHYSICS Studies in Chinese Science
Nai Hsien Mao Jul. 1992 50 p
(PB93-134450; SCS-92-2) Avail: CASI HC A03/MF A01

Shock wave research encompasses many different disciplines. Chinese research on solids is discussed based on available open literature sources. Topics covered are divided into seven groups, i.e., review and tutorial; equations of state; phase transition; geological materials; modeling and simulations; experimental techniques; and mechanical properties. GRA

N93-22760# Lawrence Livermore National Lab., CA.
WITNESS PLATE SHOCK VELOCITY STUDY
R. J. Olness 16 Oct. 1992 27 p
(Contract W-7405-eng-48)
(DE93-005742; UCRL-ID-112502) Avail: CASI HC A03/MF A01

This report describes computational analyses undertaken in support of the ICF Program hohlraum-driven witness plate experiments (Phillion 1990). Following a theoretical shock response study of the materials involved (glass and aluminum), the work reported here includes an investigation of opacity modifications, sensitivity to modelling alternatives, and an analysis of the generation process and stability for a shock driven by a thermal source. DOE

N93-22951# Florida State Univ., Tallahassee.
RECENT RESULTS OF MULTIMAGNETICAL SIMULATIONS OF THE ISING MODEL
U. Hansmann, B. A. Berg, and T. Neuhaus (Bielefeld Univ., Germany.) 1992 9 p Presented at the Dynamics of First Order Phase Transitions Workshop, Juelich, Germany, 1-3 Jun. 1992
(Contracts DE-FG05-87ER-40319; DE-FC05-85ER-25000)
(DE93-005213; CONF-9206333-1) Avail: CASI HC A02/MF A01

To investigate order-order interfaces, we perform multimagnetical Monte Carlo simulations of the 2D and 3D Ising model. Stringent tests of the numerical methods are performed by reproducing with high precision exact 2D results. In the physically more interesting 3D case we estimate the amplitude F(sup s)(sub 0) of the critical interfacial tension. DOE

N93-23198 Ohio State Univ., Columbus.
STABILITY ANALYSIS AND MODELING OF ROTATING FLEXIBLE STRUCTURES Ph.D. Thesis
Clark Richard Dohrmann 1992 149 p
Avail: Univ. Microfilms Order No. DA9238162

Equations of motion are developed for undamped, rotating flexible structures free of applied forces and moments. The development is based upon the use of a floating reference frame which follows the overall rigid body motion of the structure. Within this frame, elastic deformations are expressed as functions of n generalized degrees of freedom. A nonlinear transformation of variables is devised which shows the equivalence of the equations of motion to a Hamiltonian system with n + 1 degrees of freedom. A method is developed for the stability analysis of flexible structures rotating about this axis of minimum moment of inertia. Central to the development is the equivalence established between the governing equations and a Hamiltonian system. It is shown that unstable motion can occur only if a certain characteristic frequency of the system is involved in a lower-order resonance relation. Stability criteria for systems satisfying a single resonance relation are developed in detail. General guidelines are also provided for assessing the stability of systems possessing multiple resonance relations. Examples are provided which demonstrate the application of the stability criteria. Results obtained from numerical integration of the equations of motion are shown to be consistent with the predictions of stability analyses. It also shows that motion which is stable in the linear approximation may be unstable when nonlinear terms are included. A new method for modeling the dynamics of rotating flexible structures is developed and investigated. The method is similar to conventional assumed displacement approaches with the addition that quadratic terms are retained in the kinematics of deformation. Retention of these terms is shown to account for the geometric stiffening effects which occur in rotating structures. Computational techniques are developed for the practical implementation of the new method. The techniques make use of finite element analysis results, and thus are applicable to a wide variety of structures. Motion studies of specific problems are provided to demonstrate the validity of the method. Excellent agreement is found both with results from the literature and ones obtained from a commercial finite element analysis code. The computational advantages of the method are demonstrated.
Dissert. Abstr.

N93-23337# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
CONFIGURATION SPACE FADDEEV CALCULATIONS
G. L. Payne, W. H. Klink, and W. N. Polyzou Dec. 1992 15 p
(Contract DE-FG02-86ER-40286)
(DE93-006080; DOE/ER-40286/6) Avail: CASI HC A03/MF A01

The detailed study of few-body systems provides one of the most precise tools for studying the dynamics of nuclei and nucleons. This research program consists of a careful theoretical study of few-body systems and methods for modeling these systems. During the past year several aspects of this program were completed. Brief summaries are given of work on the following topics: the relativistic three quark problem; the relativistic Balian-Brezin method; spin in light front quantum mechanical models; proton-deutron scattering and reactions; point form relativistic quantum mechanics of constituents; solutions of quantum mechanical anharmonic oscillators; and shift operators and the U(N) multiplicity problem. DOE

N93-24308# President's Council of Advisors on Science and Technology, Washington, DC.
MEGAPROJECTS IN THE SCIENCES
Dec. 1992 44 p
(PB93-140002) Avail: CASI HC A03/MF A01

Large scientific projects or megaprojects, which are the focus of the report, have become essential components of the global scientific endeavor. The report examines the histories and costs of current and past megaprojects, as well as the scientific and policy judgements that underline them, all in the context of national and international imperatives to expand the frontiers of scientific knowledge. GRA

N93-24447# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
FESDIF: FINITE ELEMENT SCALAR DIFFRACTION THEORY CODE
H. G. Kraus Sep. 1992 242 p
(Contract DE-AC07-76ID-01570)
(DE93-007222; EGG-APO-10531) Avail: CASI HC A11/MF A03

This document describes the theory and use of a powerful scalar diffraction theory based computer code for calculation of intensity fields due to diffraction of optical waves by two-dimensional planar apertures and lenses. This code is called FESDIF (Finite Element Scalar Diffraction). It is based upon both Fraunhofer and Kirchhoff scalar diffraction theories. Simplified routines for circular apertures are included. However, the real power of the code comes from its basis in finite element methods. These methods allow the diffracting aperture to be virtually any geometric shape, including the various secondary aperture obstructions present in telescope systems. Aperture functions, with virtually any phase and amplitude variations, are allowed in the aperture openings. Step change aperture functions are accommodated. The incident waves are considered to be monochromatic. Plane waves, spherical waves, or Gaussian laser beams may be incident upon the apertures. Both area and line integral transformations were developed for the finite element based diffraction transformations. There is some loss of aperture function generality in the line integral transformations which are typically many times more computationally efficient than the area integral transformations when applicable to a particular problem.
DOE

N93-24463# Stanford Linear Accelerator Center, CA.
ANTI-GRAVITY: THE KEY TO 21ST CENTURY PHYSICS
H. P. Noyes Jan. 1993 13 p Presented at the 14th Annual Meeting of the Alternative Natural Philosophy Association, Cambridge, England, 3-6 Sep. 1992
(Contract DE-AC03-76SF-00515)
(DE93-006929; SU-SLAC-PUB-5857; CONF-9209297-1) Avail: CASI HC A03/MF A01

The masses coupling constants and cosmological parameters obtained using our discrete and combinatorial physics based on discrimination between bit-strings indicate that we can achieve the unification of quantum mechanics with relativity which had become the goal of twentieth century physics. To broaden our case we show that limitations on measurement of the position and velocity of an individual massive particle observed in a colliding beam scattering experiment imply real, rational commutation relations between position and velocity. Prior to this limit being pushed down to quantum effects, the lower bound is set by the available technology, but is otherwise scale invariant. Replacing force by force per unit mass and force per unit charge allows us to take over the Feynman-Dyson proof of the Maxwell Equations and extend it to weak gravity. The crossing symmetry of the individual scattering processes when one or more particles are replaced by anti-particles predicts both Coulomb attraction (for charged particles) and a Newtonian repulsion between any particle and its anti-particle. Previous quantum results remain intact, and predict the expected relativistic fine structure and spin dependencies. Experimental confirmation of this anti-gravity prediction would inaugurate the physics of the twenty-first century. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation.
For noise pollution see *45 Environmental Pollution.*

N93-22553*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
VIBRATION PATTERN IMAGER (VPI): A CONTROL AND DATA ACQUISITION SYSTEM FOR SCANNING LASER VIBROMETERS
Stephen A. Rizzi, Donald E. Brown (Lockheed Engineering and Sciences Co., Hampton, VA.), and Thomas A. Shaffer Jan. 1993 32 p
(RTOP 505-63-50-10)
(NASA-TM-107721; NAS 1.15:107721) Avail: CASI HC A03/MF A01

The Vibration Pattern Imager (VPI) system was designed to control and acquire data from scanning laser vibrometer sensors. The PC computer based system uses a digital signal processing (DSP) board and an analog I/O board to control the sensor and to process the data. The VPI system was originally developed for use with the Ometron VPI Sensor, but can be readily adapted to any commercially available sensor which provides an analog output signal and requires analog inputs for control of mirror positioning. The sensor itself is not part of the VPI system. A graphical interface program, which runs on a PC under the MS-DOS operating system, functions in an interactive mode and communicates with the DSP and I/O boards in a user-friendly fashion through the aid of pop-up menus. Two types of data may be acquired with the VPI system: single point or 'full field.' In the single point mode, time series data is sampled by the A/D converter on the I/O board (at a user-defined sampling rate for a selectable number of samples) and is stored by the PC. The position of the measuring point (adjusted by mirrors in the sensor) is controlled via a mouse input. The mouse input is translated to output voltages by the D/A converter on the I/O board to control the mirror servos. In the 'full field' mode, the measurement point is moved over a user-selectable rectangular area. The time series data is sampled by the A/D converter on the I/O board (at a user-defined sampling rate for a selectable number of samples) and converted to a root-mean-square (rms) value by the DSP board. The rms 'full field' velocity distribution is then uploaded for display and storage on the PC. Author

N93-22673*# Cambridge Acoustical Associates, Inc., MA.
AEROACOUSTIC DIFFRACTION AND DISSIPATION BY A SHORT PROPELLER COWL IN SUBSONIC FLIGHT Final Report
Rudolph Martinez Apr. 1993 72 p
(Contract NAS3-26598; RTOP 535-03-10)
(NASA-CR-190801; E-7717; NAS 1.26:190801) Avail: CASI HC A04/MF A01

This report develops and applies an aeroacoustic diffraction theory for a duct, or cowl, placed around modelled sources of propeller noise. The regime of flight speed is high subsonic. The modelled cowl's inner wall contains a liner with axially variable properties. Its exterior is rigid. The analysis replaces both sides with an unsteady lifting surface coupled to a dynamic thickness problem. The resulting pair of aeroacoustic governing equations for a lined 'ring wing' is valid both for a passive and for an active liner. Their numerical solution yields the effective dipole and monopole distributions of the shrouding system and thereby determines the cowl-diffracted component of the total radiated field. The sample calculations here include a preliminary parametric search for that liner layout which maximizes the cowl's shielding effectiveness. The main conclusion of the study is that a short cowl, passively lined, should provide moderate reductions in propeller noise. Author (revised)

N93-22775# Los Alamos National Lab., NM.
INTERACTION OF EXTERNALLY-DRIVEN ACOUSTIC WAVES WITH COMPRESSIBLE CONVECTION
P. Jones, W. Merryfield (Victoria Univ., British Columbia.), and J. Toomre (Colorado Univ., Boulder.) 1992 5 p Presented at the GONG 1992: Seismic Investigations of the Sun and Stars, Boulder, CO, 11-14 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003800; LA-UR-92-3604; CONF-9208181-2) Avail: CASI HC A01/MF A01

Two-dimensional numerical simulations are used to examine the interaction of acoustic waves with a compressible convecting fluid. Acoustic waves are forced at the lower boundary of the computational domain and propagate through a three-layer system undergoing vigorous penetrative convection. Energy exchange between the wave and the fluid is analyzed using a work integral formulation. DOE

N93-22813*# Eagle Engineering, Inc., Hampton, VA.
FEASIBILITY STUDY ON CONDUCTING OVERFLIGHT MEASUREMENTS OF SHAPED SONIC BOOM SIGNATURES USING THE FIREBEE BQM-34E RPV
Domenic J. Maglieri, Victor E. Sothcott, and Thomas N. Keefer, Jr. Feb. 1993 66 p
(Contract NAS9-17900; RTOP 537-03-21-01)
(NASA-CR-189715; NAS 1.26:189715) Avail: CASI HC A04/MF A01

A study was performed to determine the feasibility of establishing if a 'shaped' sonic boom signature, experimentally shown in wind tunnel models out to about 10 body lengths, will persist out to representative flight conditions of 200 to 300 body lengths. The study focuses on the use of a relatively large supersonic remotely-piloted and recoverable vehicle. Other simulation methods that may accomplish the objective are also addressed and include the use of nonrecoverable target drones, missiles, full-scale drones, very large wind tunnels, ballistic facilities, whirling-arm techniques, rocket sled tracks, and airplane nose probes. In addition, this report will also present a background on the origin of the feasibility study including a brief review of the equivalent body concept, a listing of the basic sonic boom signature characteristics and requirements, identification of candidate vehicles in terms of desirable features/availability, and vehicle characteristics including geometries, area distributions, and resulting sonic boom signatures. A program is developed that includes wind tunnel sonic boom and force models and tests for both a basic and modified vehicles and full-scale flight tests. Author (revised)

N93-23005# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.
ZERO SOUND EXPERIMENTS IN SUPERFLUID He3 Ph.D. Thesis
Kiyoshi Torizuka 1991 51 p Sponsored by Koerber Foundation, Hamburg, Germany, and Academy of Finland
(ISBN-951-22-0841-5; ETN-93-93474) Avail: CASI HC A04/MF A01

Ultrasonic experiments in the superfluid phases of helium 3 were carried out in the rotating nuclear demagnetization cryostat ROTA2. The real squashing mode spectroscopy on rotating B phase helium 3 is described, and the behavior of sound attenuation in A phase helium 3 at low temperatures and pressure is examined. The rotation response of the sound attenuation in the A(sub 1) phase is also described. Two phonon absorption by the real squashing mode in B phase helium 3, which is the analog of two photon absorption in nonlinear optics, is discussed. The investigation of the phase diagram of rotating A phase helium 3 in low magnetic fields is presented. ESA

N93-23229# Science Applications International Corp., McLean, VA.
CHINESE RESEARCH ON UNDERWATER ACOUSTICS Studies in chinese science
Zhengxu Qian and Dong Ding Sep. 1992 83 p
(PB93-134468; SCS-92-4) Avail: CASI HC A05/MF A01

The monograph provides a baseline assessment of Chinese literature in research on the physics and technology of underwater acoustics during the last decade in China. However, developments prior to 1980 are also briefly covered, as they provide background and context for recent developments. This report will provide the following: (1) a description of research organizations and their administrative structure, professional societies, conferences, researchers, and engineers; (2) a technical review of the physics and engineering of underwater acoustics; (3) a list of underwater acoustics experts from the United States and Europe who visited China; (4) a list of underwater acoustics monography written by Chinese authors; and (5) a brief assessment of the Chinese research at the international level. GRA

N93-23682# National Inst. of Standards and Technology, Gaithersburg, MD. Automated Production Technology Div.
RESEARCH IN ULTRASONIC MEASUREMENTS AT NIST: 1982-1992
N. N. Hsu, G. V. Blessing, and F. R. Breckenridge Dec. 1992 13 p Sponsored by Office of Naval Research, Arlington, VA
(PB93-152064; NISTIR-5101) Avail: CASI HC A03/MF A01

The research in ultrasonic measurements at the National Institute of Standards and Technology (NIST) which was supported in part by the Physics Division of the Office of Naval Research from 1982 to 1992. This represents work accomplished since the last such summary report, NBSIR 82-2529, entitled 'Ultrasonic Research Summary Report and Literature Guide to the National Bureau of Standards/Office of Naval Research Program'. References to the published literature documenting the new work are included. GRA

N93-23951# National Inst. of Standards and Technology, Gaithersburg, MD.

ACOUSTIC EMISSION OF STRUCTURAL MATERIALS EXPOSED TO OPEN FLAMES

William Grosshandler and Margaret Jackson Dec. 1992 27 p
(PB93-138980; NISTIR-4984) Avail: CASI HC A03/MF A01

The use of acoustic emission (AE) as an early indicator of a hidden structural fire has been investigated and found to be a viable, but undeveloped, concept. Piezoelectric transducers have been mounted directly on 0.5 m long, simply supported beams of different structural materials (aluminum, gypsum board, wood, and plastic), and have been used to record ultrasonic events resulting from a small flame placed under the beam. The number of AE events in a minute and the cumulative energy released during the heating cycle provide a good measure of the overheated state of some of these materials even before a temperature increase is indicated. The measured signals varied in energy and number with the type of material, the thickness of the specimen, and heat flux. Wood was particularly susceptible to acoustic emission, producing more than 1000 events per minute in a solid fir board and 30/min in a 13 mm thick plywood when the flame exceeded 1.0 kW. A gypsum board produced 16 events in a minute. An aluminum plate did not respond above the background level (0.3 events/minute) even though it reached the highest temperature. The differences in cumulative energy were equally striking, with the plywood being four times more energetic than the gypsum board even though the heating period for the wood was half as long, and 30 times more energetic than the aluminum. GRA

N93-24070*# Sverdrup Technology, Inc., Brook Park, OH.

AN ASYMPTOTIC THEORY OF SUPERSONIC PROPELLER NOISE Final Report

Edmane Envia May 1992 20 p Presented at the 14th Aeroacoustics Conference, Aachen, Germany, 11-14 May 1992; sponsored by DGLR and AIAA Previously announced in IAA as A93-19169
(Contract NAS3-25266; RTOP 535-03-10)
(NASA-CR-191110; E-7723; NAS 1.26:191110) Avail: CASI HC A03/MF A01

A theory for predicting the noise field of supersonic propellers with realistic blade geometries is presented. The theory, which utilizes a large-blade-count approximation, provides an efficient formula for predicting the radiation of sound from all three sources of propeller noise. Comparisons with a full numerical integration indicate that the levels predicted by this formula are quite accurate. Calculations also show that, for high speed propellers, the noise radiated by the Lighthill quadrupole source is rather substantial when compared with the noise radiated by the blade thickness and loading sources. Results from a preliminary application of the theory indicate that the peak noise level generated by a supersonic propeller initially increases with increasing tip helical Mach number, but is eventually reaches a plateau and does not increase further. The predicted trend shows qualitative agreement with the experimental observations. Author

N93-24119# Systems Control Technology, Inc., Arlington, VA.

TILTROTOR AIRCRAFT NOISE: A SUMMARY OF THE PRESENTATIONS AND DISCUSSIONS AT THE 1991 FAA/GEORGIA TECH WORKSHOP Final Report

K. K. Ahuja Jan. 1992 55 p
(Contract DTFA01-87-C-0014)
(AD-A260072; A8924-1; DOT/FAA/RD-91/23) Avail: CASI HC A04/MF A01

Georgia Institute of Technology hosted a workshop in Atlanta on 28-29 Mar. 1991 on the noise problems associated with tiltrotors. The workshop had two major objectives: (1) to review the status of research and development in predicting and reducing tiltrotor noise; and (2) to identify key technical and operational issues and methods to address them. The second objective had both near term and far term implications. In the near term, the goal is to arrive at a level of technical credibility that can support decisions to develop urban and inner city markets. The long term goal is to target resources and actions which will lead to tiltrotor noise abatement and effective control. The opening session consisted of an overview and a discussion of the physics of tiltrotor noise mechanisms. A review of the available experiment data followed. A discourse on potential flight operational procedures to minimize noise impacts, and a general presentation of industry and government perspectives concluded the workshop. Subsequent sessions were available for participants to present observations on and experiences with the XV-15 and V-22. Operational experiences included flight tests, wind tunnel tests, and other simulations. Experiences with computational fluid dynamics codes, small-scale model testing, and other related research were shared. A summary of the presentations and discussions are provided. Author (revised)

N93-24123# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.

THE ACOUSTICAL IMPEDANCE AT THE JUNCTION OF NON-COAXIAL CYLINDRICAL DUCTS

K. S. Peat Apr. 1992 15 p
(MATHS-Rept-A-157; ETN-93-93563) Avail: CASI HC A03/MF A01

An investigation of the situation where ducts at a sudden area change are not coaxial is presented. At low frequencies, only plane waves can continuously propagate along uniform ducts, but evanescent non planar waves arise from discontinuities in the duct cross section. The effect of these evanescent waves can be considered as an acoustical impedance to the propagation of plane waves. It is then possible to increase the accuracy of low frequency planewave analysis of duct systems with cross sectional discontinuities, by inclusion of these impedance corrections. ESA

N93-24190# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

LOW ALTITUDE ACOUSTIC PROPAGATION ANALYSIS BY USE OF A THREE-DIMENSIONAL PARABOLIC WAVE EQUATION Ph.D. Thesis - Ecole Centrale de Lyon, 1991 [ANALYSE DE LA PROPAGATION ACOUSTIQUE A BASSE ALTITUDE PAR L'EQUATION PARABOLIQUE TRIDIMENSIONNELLE]

Yves Delrieux 1992 156 p In FRENCH
(ONERA-P-1992-1; ETN-93-93521) Avail: CASI HC A08/MF A02

A numerical method based on parabolic approximation used in the investigation of long range sound propagation in the atmosphere near the ground, in order to predict noise levels of industrial plants, traffic or aircraft is discussed. It can be described by means of numerical resolution of the wave equation. The two Dimensional Parabolic Equation (2PDE) is generally applied to describe sound propagation from a point source in a media which is assumed to be cylindrically symmetric. The aim is to study the three dimensional effects in sound propagation by use of the 3DPE. A numerical method for solving the 3DPE is presented and an implicit finite difference scheme based on the alternating directions method is formulated. The validity of the 3DPE is shown by comparison with measurements carried out in an anechoic chamber where the diffraction behind a thin barrier of finite length is studied. The 3D effects of wind and topology are shown by experimentations carried out in a wind tunnel for different types of wedges and screens. ESA

N93-24572# Harris, Miller, Miller and Hanson, Inc., Lexington, MA.

AIRCRAFT OVERFLIGHT STUDY: EFFECT OF AIRCRAFT ALTITUDE UPON SOUND LEVELS AT THE GROUND

Grant S. Anderson and Richard D. Horonjeff Mar. 1992 80 p Sponsored by National Park Service, Denver, CO
(Contract NPS-DSC-CX-2000-0-0025)
(PB93-144194; HMMH-290940.02; NPOA-91-4) Avail: CASI HC A05/MF A01

The report summarizes that literature review, discussing sound divergence, atmospheric absorption, attenuation due to intervening hills and heavily wooded areas, soft-ground attenuation, and the acoustical descriptors that are of potential concern to the Park Service as the aircraft flies by the area. Finally, the report concludes with a summary of the effect of aircraft altitude upon sound levels on the ground, taking all these

factors into account. Included in the summary is a discussion of the potential acoustical effectiveness of using altitude as a mitigation measure for any adverse effects of aircraft sound within the National Park System. GRA

N93-24602* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FIBER OPTIC MICROPHONE HAVING A PRESSURE SENSING REFLECTIVE MEMBRANE AND A VOLTAGE SOURCE FOR CALIBRATION PURPOSE Patent
Allan J. Zuckerwar, inventor (to NASA), Frank W. Cuomo, inventor (to NASA), and William E. Robbins, inventor (to NASA) 6 Apr. 1993 16 p Filed 3 Jun. 1992 Division of US-Patent-Appl-SN-586369, filed 21 Sep. 1990
(NASA-Case-LAR-14402-2-CU; US-Patent-5,200,610; US-Patent-Appl-SN-894504; US-Patent-Class-250-227.21; US-Patent-Class-250-231.19; US-Patent-Class-364-571.01; Int-Patent-Class-H01J-40/14) Avail: US Patent and Trademark Office

A fiber optic microphone is provided for measuring fluctuating pressures. An optical fiber probe having at least one transmitting fiber for transmitting light to a pressure-sensing membrane and at least one receiving fiber for receiving light reflected from a stretched membrane is provided. The pressure-sensing membrane may be stretched for high frequency response. Further, a reflecting surface of the pressure-sensing membrane may have dimensions which substantially correspond to dimensions of a cross section of the optical fiber probe. Further, the fiber optic microphone can be made of materials for use in high temperature environments, for example greater than 1000 F. A fiber optic probe is also provided with a back plate for damping membrane motion. The back plate further provides a means for on-line calibration of the microphone.
Official Gazette of the U.S. Patent and Trademark Office

N93-24649# Harris, Miller, Miller and Hanson, Inc., Lexington, MA.
AIRCRAFT OVERFLIGHT STUDY RECOMMENDED PLAN: DETAILED SAMPLING, DATA COLLECTION AND DATA ANALYSIS PLANS FOR THE VISITOR SURVEY AND THE DOSE-RESPONSE SURVEY
Robert M. Baumgartner, Cary McDonald, Ronald Iachan, Grant S. Anderson, Richard D. Horonjeff, Christopher W. Menge, and Nicholas P. Miller Apr. 1992 145 p Sponsored by National Park Service Prepared in cooperation with HBRS, Inc., Madison, WI, and Research Triangle Inst., Research Triangle Park, NC
(Contract NPS-DSC-CX-2000-0-0025)
(PB93-144186; HMMH-290940.08; NPOA-91-6) Avail: CASI HC A07/MF A02

The report describes the recommended study design for an National Park Service (NPS) area visitor survey and a dose-response study to be conducted as part of the research for the NPS Aircraft Overflight Study. The NPS Aircraft Overflight Study is based upon the directives for research contained Public Law 100-91. That document states that the study should: (1) determine the proper minimum altitude for aircraft flying over park units; (2) identify any problems associated with aircraft overflights of park units; (3) provide information regarding the types of overflights which may impact park units; (4) distinguish between impacts caused by different types of aircraft activity; and (5) identify park system units and portions where the most serious impacts exist. GRA

N93-24365# Akustische und Kino-Geraete G.m.b.H., Vienna (Austria).
AUDIMIR: DIRECTIONAL HEARING AT MICROGRAVITY
A. Persterer, M. Berger (Innsbruck Univ., Austria.), C. Koppensteiner (Technische Univ., Graz, Austria.), C. Mueller (Wien Univ., Austria.), M. Nefjodova (Institute of Biomedical Problems, Moscow, USSR.), M. Opitz, and P. Schneider (Wien Univ., Austria.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratotries Jul. 1992 p 157-162 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N93-22031# Lawrence Livermore National Lab., CA.
ELECTRON IMPACT EXCITATION CROSS SECTION MEASUREMENTS OF HIGHLY CHARGED HELIUMLIKE AND LITHIUMLIKE IONS
K. L. Wong, P. Beiersdorfer, R. E. Marrs, K. J. Reed, and D. A. Vogel 15 Sep. 1992 4 p Presented at the 6th International Conference on Physics of Highly Charged Ions, Manhattan, KS, 28 Sep. - 2 Oct. 1992
(Contract W-7405-eng-48)
(DE93-003478; UCRL-JC-111467; CONF-920948-9) Avail: CASI HC A01/MF A01

The cross sections for electron impact excitation of the heliumlike forbidden line z, intercombination lines y and x, and the resonance line w, together with the associated lithiumlike satellites lines q, r, t, u, and v have been measured for Ti, V, Cr, Mn, and Fe on the Livermore electron beam ion trap. The measurements were made near the threshold for excitation of the heliumlike transitions where no other processes can contribute to the excitation of the lines. The uncertainties in the measurements are up to 15 percent for the heliumlike transitions and between 14 and 27 percent for the lithiumlike transitions. We find good agreement with results from a distorted-wave calculation. DOE

N93-22050# Pennsylvania State Univ., University Park.
ELECTRON TRANSFER, IONIZATION, AND EXCITATION IN ATOMIC COLLISIONS
1992 4 p
(Contract DE-FG02-86ER-13549)
(DE93-005918; DOE/ER-13549/7) Avail: CASI HC A01/MF A01

Fundamental processes of electron transfer, ionization, and excitation in ion-atom and ion-ion collisions are studied. Attention is focussed on one- and two-electron systems and, more recently, quasi-one-electron systems whose electron-target-ion core can be accurately modeled by one-electron potentials. The basic computational approaches can then be taken with few, if any, approximations, and the underlying collisional mechanisms can be more clearly revealed. At intermediate collision energies (e.g., proton energies for p-He(+) collisions on the order of 100 kilo-electron volts), many electronic states are strongly coupled during the collision, a coupled-state approach, such as a coupled-Sturmian-pseudostate approach, is appropriate. At higher collision energies (million electron-volt energies) the coupling is weaker with, however, many more states being coupled together, so that high-order perturbation theory is essential. DOE

N93-22059# Argonne National Lab., IL. High Energy Physics Div.
COLOR SEXTET QUARKS AND NEW HIGH-ENERGY INTERACTIONS
A. R. White and Kyungsik Kang (Brown Univ., Providence, RI.) 28 Oct. 1992 8 p Presented at the 7th International Symposium on Very High Energy Cosmic Ray Interactions, Ann Arbor, MI, 21-27 Jun. 1992
(Contract W-31-109-eng-38)
(DE93-004187; ANL-HEP-CP-92-90; BROWN-HET-883; CONF-9206284-2) Avail: CASI HC A02/MF A01

We review the implications of adding a flavor doublet of color sextet quarks to QCD. Theoretical attractions include--'minimal' dynamical symmetry breaking of the electroweak interaction, solution of the Strong CP problem via the 'heavy axion' eta(sub 6), and Critical Pomeron Scaling at asymptotic energies. Related experimental phenomena, which there may be evidence for, include--production of the eta(sub 6) at LEP, large cross-sections for W(sup +)W(sup -) and Z(sup 0)Z(sup 0) pairs and very high energy jets in hadron colliders, and a hadronic threshold above which high-energy 'exotic' diffractive processes appear in Cosmic Ray events. DOE

N93-22063# Argonne National Lab., IL. Physics Div.
FROM SIMPLE TO COMPLEX REACTIONS: NUCLEAR COLLISIONS NEAR THE COULOMB BARRIER
K. E. Rehm 1992 15 p Presented at the 27th Zakopane School of Physics Conference, Zakopane, Poland, 31 Aug. - 3 Sep. 1992
(Contract W-31-109-eng-38)
(DE93-004197; ANL/PHY/CP-77920; CONF-9208190-1) Avail: CASI HC A03/MF A01

Collisions between two heavy nuclei produce a diverse spectrum of

reaction modes which is much wider than that observed in light ion studies. For the latter case, two processes are observed: direct reactions and compound nucleus formation. Heavy ion reaction studies on the other hand have identified additional processes such as deep-inelastic scattering, incomplete fusion, and quasi-fission reactions. While the boundaries between the various processes are usually not well defined, it is generally accepted that with increasing overlap of the two nuclei, the interaction evolves from distant collisions where only elastic scattering and Coulomb excitation processes occur, through grazing-type collisions associated with quasi-elastic reactions to deep-inelastic and fusion-fission processes requiring a substantial nuclear overlap. Varying the bombarding energy is a convenient way to change the overlap of the two nuclei. Measurements of excitation functions can thus probe the onset and the interplay of the various reaction modes. Experiments at bombarding energies in the vicinity of the Coulomb barrier are particularly suited for comparisons with theoretical predictions since the small number of degrees of freedom involved in the interaction greatly simplifies the calculations. In the first part of this contribution a short overview is given on the status of heavy ion reaction studies at energies in the vicinity of the Coulomb barrier. In the second part, two experiments, one involving simple and the other studying complex reactions, are discussed in more detail. DOE

N93-22068# Los Alamos National Lab., NM.
DIRECT SEARCHES FOR NEUTRINO MASS
J. F. Wilkerson 1992 11 p Presented at the 15th International Conference on Neutrino Physics, Granada, Spain, 7-13 Jun. 1992
(Contract W-7405-eng-36)
(DE93-003867; LA-UR-92-3956; CONF-9206227-4) Avail: CASI HC A03/MF A01

At present there is no positive experimental evidence that neutrinos have mass. Nevertheless, searches for neutrino mass continue, largely because the consequences of neutrinos having mass would be quite profound. In particular, the discovery of a non-zero neutrino mass would be a clear indication of physics beyond the current particle-physics standard model. In addition, neutrinos, if they have mass, remain viable candidates for the non-baryonic dark matter known to permeate galaxies. The current status of the experimental efforts searching for neutrino mass will be reviewed. In particular, it will be shown that the most recent tritium beta decay searches for neutrino mass clearly rule out the non-zero neutrino mass result first reported in 1980 by the Institute for Theoretical and Experimental Physics (ITEP) in Moscow. However, a troubling feature of these same recent results is that they all have best fits to neutrino mass squared that are negative. The significance of these negative neutrino mass squared results will be explored. DOE

N93-22070# Oak Ridge National Lab., TN.
THEORY OF ELECTRON EJECTION FROM SURFACES BY HIGHLY CHARGED ION IMPACT
S. Y. Ovchinnikov and J. Macek (Tennessee Univ., Knoxville.) 1992 8 p Presented at the 6th International Conference on Physics of Highly Charged Ions, Manhattan, KS, 28 Sep. - 2 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004109; CONF-920948-10) Avail: CASI HC A02/MF A01

The purpose of this work is to present a simple model for electron production in ion-surface collisions. Additionally, an attempt is made to develop expressions for the electron energy distribution based on this model. DOE

N93-22333# California Univ., Berkeley. Lawrence Berkeley Lab.
A MASSIVE NEUTRINO IN NUCLEAR BETA DECAY?
E. B. Norman, Yuen-Dat Chan, A. Garcia, K. T. Lesko, R. M. Larimer, R. G. Stokstad, B. Sur, I. Zlimen, and M. T. F. daCruz Aug. 1992 5 p Presented at the ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) Conference on High Energy Physics, Dallas, TX, 6-12 Aug. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004718; LBL-32953; CONF-920837-30) Avail: CASI HC A01/MF A01

We have continued our studies of the p-spectrum of C-14 using a germanium detector doped with C-14. There is a feature in the beta-spectrum 17 keV below the endpoint which could be explained by the hypothesis that there is a heavy neutrino emitted in the beta-decay of C-14 with a mass of 17 +/- 1 keV and an emission probability of 1.26 +/- 0.25 percent. However, we also have performed a high statistics measurement of the inner bremsstrahlung spectrum of Fe-55 and find no indication of the emission of a 17-keV neutrino. We conclude that the origin of the 'kink' that has been observed in some recent beta spectral measurements is not a neutrino. DOE

N93-22418# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
HIGH PRESSURE HETEROGENEOUS CATALYSIS IN A LOW PRESSURE ULTRAHIGH VACUUM ENVIRONMENT
S. T. Ceyer 1992 5 p
(Contract DE-FG02-89ER-14035)
(DE93-005917; DOE/ER-14035/T2) Avail: CASI HC A01/MF A01

An apparatus was developed which couples high resolution electron energy loss spectroscopy with molecular beam and scattering techniques. Exposure of Ni(111) to atomic H results in H embedded within the Ni lattice and a monolayer of H adsorbed on the surface. This surface-bound H was removed by an Xe atom beam. Subsequent exposure to CH4 results in dissociative adsorption, producing adsorbed CH3, and adsorbed H. Results document a new mechanism for a surface reaction, a reaction between an adsorbed and a bulk species, and demonstrate the importance of bulk H as a reactant in a heterogeneous catalytic reaction. DOE

N93-22525# Los Alamos National Lab., NM.
EXCPACK: A PACKAGE OF CODES FOR ELECTRON IMPACT EXCITATION OF IONS BY A DISTORTED WAVE METHOD
J. B. Mann Dec. 1992 130 p
(Contract W-7405-eng-36)
(DE93-006095; LA-12394-MS) Avail: CASI HC A07/MF A02

EXCPACK is a package of codes and sample data decks for calculation of ion or atom excitation by electron impact. Programs RCN32 and ARRANGE produce the necessary orbital wavefunctions in form for the main program EXCITE. This program is for excitation between 'pure' LS-coupled basis functions. Two auxiliary programs, RCN2 and RCG2, calculate the mix, or composition, of LS basis functions in the actual configurations of interest. The RCG9 program also calculates various atomic energy levels, to provide any unknown excitation threshold energies. Program MIX uses the matrix elements from multiple EXCITE runs to include the effects of intermediate coupling and configuration interaction. The results from MIX are tabulated for level-to-level transitions as well as the average configuration-to-configuration transition. Auxiliary programs SORTAPE, COMBINE, UNITARY, and TAP3ED are described. Writeups of some of the programs are included here as appendixes. The package is available on a 3.5 in. PC-diskette from Group T-4 of this Laboratory. DOE

N93-22541# Los Alamos National Lab., NM.
FUNDAMENTAL SYMMETRY TESTS WITH ANTIHYDROGEN
R. J. Hughes 1992 23 p Presented at the 2nd Biennial Conference on Low-Energy Antiproton Physics, Courmayeur, Italy, 14-19 Sep. 1992
(Contract W-7405-eng-36)
(DE93-005467; LA-UR-92-4337; CONF-9209122-2) Avail: CASI HC A03/MF A01

The prospects for testing CPT invariance and the weak equivalence principle (WEP) for antimatter with spectroscopic measurements on antihydrogen are discussed. The potential precisions of these tests are compared with those from other measurements. The arguments involving energy conservation, the behavior of neutral kaons in a gravitational field and the equivalence principle for antiparticles are reviewed in detail. DOE

N93-22542# Los Alamos National Lab., NM.
MESON FORM-FACTORS AND WAVE-FUNCTIONS WITH WILSON FERMIONS
Rajan Gupta, David Daniel, and Jeffrey Grandy 1992 4 p Presented at the LATTICE 1992: Lattice field theory, Amsterdam, Netherlands, 15-19 Sep. 1992
(Contract W-7405-eng-36)
(DE93-003859; LA-UR-92-3857; CONF-9209276-2) Avail: CASI HC A01/MF A01

Results for semi-leptonic form-factors for the process D-Klv and the Bethe-Sathe-Salpeter amplitudes (BSA) for pion and eho mesons are presented. The form-factor data is consistent with previous calculations.

We find that the long distance fall-off BSA for both pi and pho is very well fit by an exponential, but surprisingly the effective mass governing the fall-off is lighter than the pion's. Lastly, by studying the dependence of pho polarization on separation direction we show that there is a measureable I=2 state in addition to I=0 in the BSA for the pho. GRA

N93-22543# Mississippi Univ., University. Dept. of Physics and Astronomy.

CHARM PHYSICS AT FERMILAB E791

S. Amato (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.), J. C. Anjos (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.), I. Bediaga (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.), I. Costa (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.), J. R. T. deMelloNeto (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.), J. deMiranda (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.), A. F. S. Santoro (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.), M. H. G. Souza (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.), G. Blaylock, and P. R. Burchat et al 26 May 1992 6 p Presented at the 27th Rencontres De Moriond: Electroweak Interactions and Unified Theories, Les Arcs, France, 15-22 Mar. 1992

(Contract DE-FG05-91ER-40622)

(DE93-006020; CONF-9203197-1) Avail: CASI HC A02/MF A01

Experiment 791 at Fermilab's Tagged Photon Laboratory has just accumulated a high statistics charm sample by recording 20 billion events on 24000 8mm tapes. A 500 GeV/c pi(-) beam was used with a fixed target and a magnetic spectrometer which now includes 23 silicon microstrip planes for vertex reconstruction. A new data acquisition system read out 9000 events/sec during the part of the Tevatron cycle that delivered beam. Digitization and readout took 50 microS per event. Data was buffered in eight large FIFO memories to allow continuous event building and continuous tape writing to a wall of 42 Exabytes at 9.6 MB/sec. The 50 terabytes of data buffered to tape is now being filtered on RISC CPU's. Preliminary results show D(sup 0) yields K(-)pi(+) and D(+) yields K(-)pi(-)pi(+) decays. Rarer decays will be pursued. DOE

N93-22585# Brookhaven National Lab., Upton, NY.

PHYSICS OPPORTUNITIES WITH HIGHER ENERGY PION BEAMS

C. B. Dover Dec. 1992 18 p Presented at the Workshop on the Future Directions of Physics At Hadron Beam Facilities At Higher Energies, Santa Fe, NM, 13 Oct. 1992

(Contract DE-AC02-76CH-00016)

(DE93-006678; BNL-48364; CONF-9210287-2) Avail: CASI HC A03/MF A01

We provide a preview of the physics issues which could be addressed with intense beams of pions in the 1-2 GeV/c region. These include: the exploitation of the (pi(+), K(+)) associated production reaction on proton and nuclear targets for high resolution studies of hypernuclear structure and decays, as well as Lambda-proton scattering, the use of pion reactions with hydrogen or deuterium targets to provide tagged eta beams for studies of rare decays, precision studies of baryon resonances which couple to the pi N system, and the exploration of pion elastic, inelastic, and charge exchange reactions above the (3,3)-resonance as a tool for the study of nuclear structure. DOE

N93-22687# Fermi National Accelerator Lab., Batavia, IL.

SEARCH FOR EXOTIC PARTICLES AT CDF

M. S. Gold Oct. 1992 8 p Presented at the ICHEP-26: 26th International Union of Pure and Applied Physics Conference on High Energy Physics, Dallas, TX, 6-12 Aug. 1992

(Contract DE-AC02-76CH-03000)

(DE93-004421; FNAL/C-92/287-E; CONF-920837-35) Avail: CASI HC A02/MF A01

We have searched for exotic particles in bar-p p collisions at 1.8 TeV in data taken with the Collider Detector at Fermilab. We review our published limits on W' and Z' masses, and on the scale of lepton-quark compositeness. We also report preliminary mass limits based on searches for leptoquarks, supersymmetric quarks and gluons, and exotic, stable colored fermions. DOE

N93-22693# Fermi National Accelerator Lab., Batavia, IL.

A STUDY OF FOUR-JET EVENTS AND SEARCH FOR DOUBLE PARTON INTERACTIONS AT SQUARE ROOT OF s = 1.8 TeV

L. J. Keeble (Texas A&M Univ., College Station.) Nov. 1992 5 p Presented at the Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL, 10-14 Nov. 1992

(Contract DE-AC02-76CH-03000)

(DE93-005973; FNAL/C-92/339-E; CONF-921122-23) Avail: CASI HC A01/MF A01

Kinematic properties of four-jet events in bar-p p collisions at sqr. of s = 1.8 TeV are compared with the predictions of leading order quantum chromodynamics. We place an upper limit on the double parton scattering cross of sigma(sub DP) less than 120 nb (95 percent C.L.) for partons with transverse momenta greater than 18 GeV/c. Defining the effective cross section sigma(sub eff) through the equation of sigma(sub eff) = sigma(sub DP) = sigma(sub dijet)(exp 2)/sigma(sub eff)), where (sigma)(sub dijet) is the cross section for two-jets events, the limit sigma(sub eff) greater than 3.9 mb (95 percent C.L.) is also placed. Implications for physics at the SSC (sqr. of s = 40 TeV) are discussed. DOE

N93-22712# Massachusetts Inst. of Tech., Cambridge.

SPECTROSCOPIC AND DYNAMICAL STUDIES OF HIGHLY ENERGIZED SMALL POLYATOMIC MOLECULES

1992 12 p

(Contract DE-FG02-87ER-13671)

(DE93-006504; DOE/ER-13671/10) Avail: CASI HC A03/MF A01

Stimulated emission pumping (SEP) spectroscopy was used on acetylene and on formyl radical. An attempt was made for pattern recognition based on statistics; a method was invented that combined CNPI (complete nuclear permutation-inversion) group theory and SCC (spectral cross-correlation). But the direction away from statistical pattern recognition back to traditional spectroscopic pattern recognition was taken. Vibrational states and quantum numbers are discussed. For the formyl radical, the fluorescence excitation spectrum was recorded and a rotational analysis of the 0(sup 0)(sub 0) band performed. DOE

N93-22714# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.

ADVANCED COMPUTATIONAL METHODS FOR NODAL DIFFUSION, MONTE CARLO, AND S(SUB N) PROBLEMS

W. R. Martin Jan. 1993 28 p

(Contract DE-FG02-92ER-75709)

(DE93-006816; DOE/ER-75709/1) Avail: CASI HC A03/MF A01

This document describes progress on five efforts for improving effectiveness of computational methods for particle diffusion and transport problems in nuclear engineering: (1) Multigrid methods for obtaining rapidly converging solutions of nodal diffusion problems. An alternative line relaxation scheme is being implemented into a nodal diffusion code. Simplified P2 has been implemented into this code. (2) Local Exponential Transform method for variance reduction in Monte Carlo neutron transport calculations. This work yielded predictions for both 1-D and 2-D x-y geometry better than conventional Monte Carlo with splitting and Russian Roulette. (3) Asymptotic Diffusion Synthetic Acceleration methods for obtaining accurate, rapidly converging solutions of multidimensional SN problems. New transport differencing schemes have been obtained that allow solution by the conjugate gradient method, and the convergence of this approach is rapid. (4) Quasidiffusion (QD) methods for obtaining accurate, rapidly converging solutions of multidimensional SN Problems on irregular spatial grids. A symmetrized QD method has been developed in a form that results in a system of two self-adjoint equations that are readily discretized and efficiently solved. (5) Response history method for speeding up the Monte Carlo calculation of electron transport problems. This method was implemented into the MCNP Monte Carlo code. In addition, we have developed and implemented a parallel time-dependent Monte Carlo code on two massively parallel processors. DOE

N93-22719# University of Southern California, Los Angeles. Dept. of Electrical Engineering.

PHOTON ACCELERATION VIA LASER-PRODUCED IONIZATION FRONTS

R. L. Savage, Jr., R. P. Brogle, W. B. Mori, and C. Joshi 1992 3 p Presented at the 8th International Conference on Ultrafast Phenomena, Antibes, France, 8-12 Jun. 1992

(Contract DE-FG03-91ER-12114)

(DE93-005205; CONF-9206118-2) Avail: CASI HC A01/MF A01

Microwave radiation has been upshifted in frequency and compressed

in duration by more than a factor of five via its interaction with a relativistically propagating, underdense ionization front. The experimental observations are in good agreement with theoretical predictions. DOE

N93-22739# Fermi National Accelerator Lab., Batavia, IL.
INCLUSIVE J/PSI, PSI(2S) AND b-QUARK PRODUCTION IN (-p)p COLLISIONS AT SQUARE ROOT OF s - 1.8 TeV
V. Papadimitriou Nov. 1992 6 p Presented at the ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) Conference on High Energy Physics, Dallas, TX, 6-12 Aug. 1992
(Contract DE-AC02-76CH-03000)
(DE93-004739; FNAL/C-92/252-E; CONF-920837-36) Avail: CASI HC A02/MF A01

Inclusive J/(psi) and (psi)(2S) production has been studied in p(bar p) collisions at (radical)s = 1.8 TeV with the Collider Detector at Fermilab. The products of production cross section times the branching fraction of J/(psi)((psi)(2S)) to (mu)(+)(mu)(-) are reported as functions of the J/(psi)((psi)(2S)) P(sub T) in the kinematic range P(sub T) is greater than 6 GeV/c and the absolute value of eta is less than or equal to 0.5. The products of the integrated cross section times branching fraction and the b-quark production cross section calculated from these values are also reported. DOE

N93-22743# Pacific Northwest Lab., Richland, WA.
ELECTRON-ELECTRON INTERACTIONS IN FAST NEUTRAL-NEUTRAL COLLISIONS
R. D. DuBois and S. T. Manson (Georgia State Univ., Atlanta.) Nov. 1992 11 p Presented at the 12th International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 2-5 Nov. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004841; PNL-SA-21188; CONF-921116-20) Avail: CASI HC A03/MF A01

Differential electron emission is studied for 50-500 keV H(+) and H atom impact on helium. Using the first Born formulation, it is shown that projectile electron-target electron interactions are expected to dominate the differential cross sections for low energy target electron emission induced by fast neutral projectile impact on any target. Measurements of the 15 degrees electron emission were made in order to investigate this prediction. For low impact energies, a constant ratio between the hydrogen atom and proton impact cross sections was found for emitted electron velocities less than half the projectile velocity, V(sub p). But as the collision energy increased, for electron velocities less than 0.25 V(sub p), the cross section ratio increased as the emitted electron velocity decreased. This is interpreted as a signature of projectile electron-target electron interactions becoming dominant for distant collisions between neutral particles. DOE

N93-22744# Argonne National Lab., IL. High Energy Physics Div.
RIGOROUS QCD PREDICTIONS FOR DECAYS OF P-WAVE QUARKONIA
G. T. Bodwin, E. Braaten (Northwestern Univ., Evanston, IL.), and G. P. Lepage (Cornell Univ., Ithaca, NY.) Nov. 1992 4 p Presented at the Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL, 10-14 Nov. 1992
(Contracts W-31-109-eng-38; DE-FG02-91ER-40684)
(DE93-004853; ANL-HEP-CP-92-109; CONF-921122-8) Avail: CASI HC A01/MF A01

We present a new factorization theorem for the decay rates of P-wave states of heavy quarkonia. Infrared logarithms that had appeared in previous perturbative calculations of P-wave decays are absorbed into a quantity that is related to the amplitude for the heavy quark and antiquark to be in a relative color-octet S-wave state. We predict all of the light-hadronic and electromagnetic decay rates of the chi(sub c) and h(sub c) states in terms of two phenomenological parameters. DOE

N93-22752# Oak Ridge National Lab., TN.
PHYSICS FROM PHOTON AND LEPTON-PAIR SPECTRA
G. R. Young Oct. 1992 39 p Presented at the NATO Advanced Study Inst. on Particle Production in Highly Excited Matter, Cioco, Italy, 12-25 Jul. 1992
(Contract DE-AC05-84OR-21400)
(DE93-003083; CONF-920777-2) Avail: CASI HC A03/MF A01

A discussion is given of lepton-pair and direct photon spectra observed in hadron-hadron reactions at center-of-mass energies of 5-10 GeV and higher. Examples are taken from the high-energy p - A literature. The usefulness of lepton-pairs and photons for probing the space-time development of heavy-ion reactions is noted. A brief review of such measurements as they exist presently for heavy-ion reactions is also given, together with some notes for the interested experimentalist. DOE

N93-22758# Pacific Northwest Lab., Richland, WA.
HIGH RESOLUTION STUDIES OF ATOMS AND SMALL MOLECULES
B. A. Bushaw, R. G. Tonkyn, and R. J. Miller Oct. 1992 5 p Presented at the Advanced Laser Technology for Chemical Measurements, Santa Fe, NM, 19-21 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004340; PNL-SA-21405; CONF-9210261-1) Avail: CASI HC A01/MF A01

High resolution, continuous wave lasers were utilized successfully in studies of small molecules. Examples of two-photon excitation schemes and of multiple resonance excitation sequences are discussed within the framework of the spectroscopy and dynamics of selected Rydberg states of nitric oxide. Initial results on the circular dichroism of angular distributions in photoelectron spectra of individual hyperfine states of cesium are also discussed, but no data given. DOE

N93-22883# Pennsylvania State Univ., University Park. Dept. of Physics.
THEORETICAL STUDIES IN ELEMENTARY PARTICLE PHYSICS
J. Collins 1992 9 p
(Contract DE-FG02-90ER-40577)
(DE93-005923; DOE/ER-40577/3) Avail: CASI HC A02/MF A01

Work on the following topics is summarized: polarized hard scattering, hard diffraction, gauge-invariant operators, fundamental QCD, heavy quarks, strongly interacting Ws, and instanton-induced effects in QCD. Some attention is given to the factorization theorem. DOE

N93-22898# National Inst. of Standards and Technology, Gaithersburg, MD. Ionizing Radiation Div.
ESTAR, PSTAR, AND ASTAR: COMPUTER PROGRAMS FOR CALCULATING STOPPING-POWER AND RANGE TABLES FOR ELECTRONS, PROTONS, AND HELIUM IONS
M. J. Berger Dec. 1992 31 p Sponsored by DOE
(PB93-146033; NISTIR-4999) Avail: CASI HC A03/MF A01

This report describes three computer codes, ESTAR, PSTAR and ASTAR, which calculate stopping-power and range tables for electrons, protons, or helium ions, according to methods described in ICRU Reports 37 and 49. The codes provide output for electrons in any stopping material, and for protons and helium ions in 74 materials. Executable programs are provided which can be run on IBM-compatible personal computers. FORTRAN source code is also provided for implementing the codes on other computers.
Derived from text

N93-22908# Los Alamos National Lab., NM.
H(-) BEAM NEUTRALIZATION MEASUREMENTS IN A SOLENOIDAL BEAM TRANSPORT SYSTEM
J. Sherman, E. Pitcher, R. Stevens, and P. Allison 1992 8 p Presented at the Production and Neutralization of Negative Ions and Beams, Upton, NY, 9-13 Nov. 1992
(Contract W-7405-eng-36)
(DE93-005460; LA-UR-92-4366; CONF-921145-3) Avail: CASI HC A02/MF A01

H(-) beam space-charge neutralization is measured for 65-mA, 35-keV beams extracted from a circular-aperture Penning surface-plasma source, the small-angle source. The H(-) beam is transported to a RFQ matchpoint by a two-solenoid magnet system. Beam noise is typically +/- 4 percent. A four-grid analyzer is located in a magnetic-field-free region between the two solenoid magnets. H(-) potentials are deduced from kinetic energy measurements of particles (electrons and positive ions) ejected radially from the beam channel by using a griddled energy analyzer. Background neutral gas density is increased by the introduction of additional Xe and Ar gases, enabling the H(-) beam to become overneutralized. DOE

N93-22950# California Univ., Berkeley. Lawrence Berkeley Lab.
A MASSIVE NEUTRINO IN NUCLEAR BETA DECAY?
E. B. Norman, Yuen-Dat Chan, A. Garcia, K. T. Lesko, R. M. Larimer, Robert G. Stokstad, Igor Zlimen, M. T. F. daCruz, Bhaskar Sur, and M. M. Hindi Sep. 1992 10 p Presented at the International Symposium on Weak and Electromagnetic Interactions in Nuclei, Dubna, Russian Federation, 16-22 Jun. 1992
(Contracts DE-AC03-76SF-00098; DE-FG05-87ER-40314)
(DE93-004706; LBL-32913; CONF-920682-3) Avail: CASI HC A02/MF A01

We have continued our studies of the beta-spectrum of C-14 using a germanium detector doped with C-14. There is a feature in the beta-spectrum 17 keV below the endpoint which could be explained by the hypothesis that there is a heavy neutrino emitted in the beta-decay of C-14 with a mass of 17 +/- 1 keV and an emission probability of 1.26 +/- 0.25 percent. However, we also have performed a high statistics measurement of the inner bremsstrahlung spectrum of Fe-55 and find no indication of the emission of a (sup 17)-keV neutrino. We conclude that the origin of the 'kink' that has been observed in some recent beta spectral measurements is not a neutrino. DOE

N93-22985# Argonne National Lab., IL. Physics Div.
SPECTROSCOPY OF HIGHLY-IONIZED ATOMS USING POSITION-SENSITIVE DETECTION
K. W. Kukla, A. E. Livingston, F. G. Serpa, A. S. Zacarias, H. G. Berry, R. W. Dunford, E. Kanter, S. Cheng, and J. Suleiman 1992 3 p Presented at the 6th International Conference on Physics of Highly Charged Ions, Manhattan, KS, 28 Sep. - 2 Oct. 1992
(Contracts W-31-109-eng-38; DE-FG02-92ER-14283; DE-FG05-88ER-13958)
(DE93-002914; ANL/PHY/CP-77423; CONF-920948-6) Avail: CASI HC A01/MF A01

New results of atomic structure and atomic lifetime measurements in highly-ionized few-electron atoms obtained using position-sensitive detection of extreme ultraviolet emission from excited fast ions are reported. Data are presented from experiments run at the Notre Dame Tandem Accelerator and at the Argonne ATLAS facility using beam foil spectroscopy with a photon-counting position-sensitive imaging detector. The results include excited state lifetimes in Si XI and Si XII involving both resonance transitions and Rydberg transitions, spectra of highly-ionized He-like, Li-like, and Be-like nickel including comparisons of electron capture and excitation processes for charge selected beams, and spectra and lifetimes in highly-charged bromine ions for both allowed and forbidden transitions. DOE

N93-22986# California State Univ., Los Angeles. Dept. of Physics and Astronomy.
PHYSICS STUDIES WITH ICARUS AND A HYBRID IONIZATION AND SCINTILLATION FIBER DETECTOR
D. B. Cline 1992 23 p Presented at the International Conference on Liquid Radiation Detectors: Their Fundamental Properties and Applications, Tokyo, Japan, 7-10 Apr. 1992
(Contract DE-FG03-91ER-40662)
(DE93-003034; CONF-920480-2) Avail: CASI HC A03/MF A01

We discuss the physics possibilities for the ICARUS detector currently being tested at CERN. The physics potential goes from a massive proton decay detector to the study of solar neutrinos. In addition, the detection of nu(sub mu) yields nu(sub tau) and nu(sub e) yields nu(sub tau) will be possible with such a detector. One major topic involves the possibility of a complete determination of the MSW solar neutrino parameters with the ICARUS. The possibility of detecting WIMPS with a scintillating fiber liquid Argon (Ar) detector or fiber Xenon (Xe) detector doped with Ar is also described. Some comments on the measurement of the Ar-42 level from an experiment at the Gran Sasso will be made. DOE

N93-22992# California Univ., Los Angeles.
PARTICLE PHYSICS
B. M. K. Nefkens Nov. 1992 5 p
(Contract DE-FG03-88ER-40420)
(DE93-006894; DOE/ER-40420/T4) Avail: CASI HC A01/MF A01

Research in basic particle and nuclear physics by the UCLA Particle Physics Research Group is reported in the following areas: rare decays of (eta) and (mu) to test charge conjugation invariance, QCD, and the Standard Model; tests of charge symmetry and isospin invariance; studies of baryon resonances: (pi)N scattering, inverse pion photoproduction, eta-meson photoproduction, and the production of the eta meson in pi(-)p decays to eta(n); and exploratory investigations in support of new programs (feasibility study of tagged eta meson production in p(+) H-3 decays to He-4(+)(eta), the alternative eta production reaction (pi)(+) decays to p(+)p(+)eta, particle physics with PILAC, quark physics at a phi-meson factory). DOE

N93-23244# Los Alamos National Lab., NM.
ULTRASENSITIVE DETECTION OF SINGLE MOLECULES IN FLOWING SAMPLE STREAMS BY LASER-INDUCED FLUORESCENCE
P. M. Goodwin, C. W. Wilkerson, Jr., W. P. Ambrose, and R. A. Keller 1992 12 p Presented at the International Society for Optical Engineering Conference, Los Angeles, CA, 18-22 Jan. 1993
(Contract W-7405-eng-36)
(DE93-005457; LA-UR-92-4408; CONF-930159-1) Avail: CASI HC A03/MF A01

We report on the detection and fluorescence lifetime measurement of single Rhodamine-110 molecules in a flowing, aqueous sample stream. Time-Correlated Photon Counting (TCPC) used in combination with pulsed excitation allows for the detection, in the presence of significant prompt Raman and Rayleigh background, of photon bursts due to single fluorescent molecules passing through a small detection volume (approximately 1 pL). The fluorescence lifetime of a detected molecule is estimated from the decay curve compiled from photon arrival times in the burst. DOE

N93-23298# Massachusetts Univ., Amherst. Dept. of Chemistry.
THEORY OF THE DISSOCIATION DYNAMICS OF SMALL MOLECULES ON METAL SURFACES: FINITE TEMPERATURE STUDIES
B. E. Jackson Nov. 1992 7 p
(Contract DE-FG02-87ER-13744)
(DE93-005870; DOE/ER-13744/13) Avail: CASI HC A02/MF A01

The goal is to gain a better understanding of metal-catalyzed reactions by examining in detail the dynamics of molecule-metal interactions. Much effort has been focused on treating the molecule quantum mechanically when necessary, and including the effects of finite surface temperature. Recently developed time-dependent quantum techniques have been used to compute the dissociative sticking probability of H2, HD, and D2 on Cu and Ni surfaces. All molecular degrees of freedom can now be included either quantum mechanically or classically. The dependence upon translational and internal molecular energy, the angle and site of surface impact, and the details of the molecule-metal interaction potential were examined. Similar techniques were used to study the Eley-Rideal mechanism for the recombinative desorption of adsorbed H and D atoms with gas-phase H and D atoms. Several useful methods for coupling gas particles to the thermal vibrations of the solid were developed and used in studies of energy transfer and sticking. The trapping of H2 and other diatomics in weakly bound molecular precursors to dissociative adsorption is also of interest. DOE

N93-23308# New Mexico State Univ., Las Cruces.
EXPERIMENTAL STUDIES OF PION-NUCLEUS INTERACTIONS AT INTERMEDIATE ENERGIES
31 Dec. 1992 40 p
(Contract DE-FG04-88ER-40403)
(DE93-005872; DOE/ER-40403/T4) Avail: CASI HC A03/MF A01

This report summarizes investigations of various pion-nucleus interactions and nucleon-nucleus charge-exchange reactions. The work was carried out with the LAMPF accelerator at the Los Alamos National Laboratory and the cyclotrons at the Paul Scherrer Institute (PSI) near Zurich, Switzerland, and at Indiana University (IUCF), as a collaborative effort among several laboratories and universities. The experimental activity at LAMPF involved measurements of new data on pion double-charge-exchange scattering, some initial work on a new Neutral Meson Spectrometer system, a search for deeply-bound pionic atoms, measurements of elastic scattering, and studies of the (n,p) reaction on various nuclei. At PSI measurements of pion quasielastic scattering were carried out, with detection of the recoil proton. Work on the analysis of data from a previous experiment at PSI on pion absorption in nuclei was continued. This experiment involved using a detector system that covered nearly the full solid angle. DOE

N93-23310# Oak Ridge National Lab., TN.
COMPUTER SIMULATION OF ATOMIC COLLISION PROCESSES IN SOLIDS
M. T. Robinson Nov. 1992 14 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005106; CONF-921101-15) Avail: CASI HC A03/MF A01

Computer simulation is a major tool for studying the interactions of swift ions with solids which underlie processes such as particle backscattering, ion implantation, radiation damage, and sputtering. Numerical models are classed as molecular dynamics or binary collision models, along with some intermediate types. Binary collision models are divided into those for crystalline targets and those for structureless ones. The foundations of such models are reviewed, including interatomic potentials, electron excitations, and relationships among the various types of codes. Some topics of current interest are summarized. DOE

N93-23328# College of William and Mary, Williamsburg, VA. Dept. of Physics.
NEGATIVE ION DETACHMENT CROSS SECTIONS
R. L. Champion and L. D. Doverspike Oct. 1992 7 p
(Contract DE-FG05-88ER-13874)
(DE93-005679; DOE/ER-13874/5) Avail: CASI HC A02/MF A01

The authors have measured absolute cross sections for electron detachment and charge exchange for collision of O and S with atomic hydrogen, have investigated the sputtering and photodesorption of negative ions from gas covered surfaces, and have begun an investigation of photon-induced field emission of electrons from exotic structures. Brief descriptions of these activities as well as future plans for these projects are given below. DOE

N93-23684# Valparaiso Univ., IN. Dept. of Physics and Astronomy.
HIGH SENSITIVITY TESTS OF THE STANDARD MODEL FOR *ELECTROWEAK INTERACTIONS Progress Report*
D. D. Koetke, R. W. Manweiler, and T. D. ShirvelStanislaus 1993 7 p
(Contract DE-FG02-88ER-40416)
(DE93-006186; DOE/ER-40416/5) Avail: CASI HC A02/MF A01

The work done on this project was focused on two LAMPF experiments. The MEGA experiment, a high-sensitivity search for the lepton-family-number-violating decay mu yields e(gamma) to a sensitivity which, measured in terms of the branching ratio, BR = (mu yields e(gamma))/(mu yields e v(sub mu) v(sub e)) approximately 10(sup -13), is over two orders of magnitude better than previously reported values. The second is a precision measurement of the Michel rho parameter from the positron energy spectrum of mu yields e v(sub mu) v(sub e) to test the V-A theory of weak interactions. The uncertainty in the measurement of the Michel rho parameter is expected to be a factor of three lower than the present reported value. DOE

N93-23977# Brookhaven National Lab., Upton, NY.
GALLEX: FIRST RESULTS AND IMPLICATIONS FOR NEUTRINO PHYSICS
F. X. Hartman 1992 16 p Presented at the Stanford Linear Accelerator Center (SLAC) Summer Institute on Particle Accelerators: Third Family and the Physics of Flavor, Stanford, CA, 13-24 Jul. 1992
(Contract DE-AC02-76CH-00016)
(DE93-004908; BNL-48251; CONF-9207140-3) Avail: CASI HC A03/MF A01

The GALLEX experiment, located in the Gran Sasso underground laboratory, completed its first measurements of the production rate of Ge-71 from Ga-71 due to solar neutrinos. The GALLEX detector is uniquely sensitive to the low energy neutrinos produced by proton-proton fusion in the center of the Sun. From these first measurements, which cover a period of exposure of 295 days, a rate of 83 plus/minus 19 (stat.) plus/minus 8 (syst.) (1 sigma) SNU (1 x 10'(-36)) captures/target atom - second) is reported. This initial result is two standard deviations below the solar model calculations. The implications of a neutrino deficit in terms of neutrino flavor oscillations is summarized. DOE

N93-24029# Argonne National Lab., IL. High Energy Physics Div.
OVERVIEW OF SPIN PHYSICS
A. Yokosawa 23 Dec. 1992 36 p Presented at the 1992 Artificial Neural Networks in Engineering Conference, St. Louis, MO, 15-18 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-006412; ANL-HEP-CP-93-01; CONF-921185-1) Avail: CASI HC A03/MF A01

Spin physics activities at medium and high energies became significantly active when polarized targets and polarized beams became accessible for hadron-hadron scattering experiments. My overview of spin physics will be inclined to the study of strong interaction using facilities at Argonne ZGS, Brookhaven AGS (including RHIC), CERN, Fermilab, LAMPF, an SATURNE. In 1960 accelerator physicists had already been convinced that the ZGS could be unique in accelerating a polarized beam; polarized beams were being accelerated through linear accelerators elsewhere at that time. However, there was much concern about going ahead with the construction of a polarized beam because (1) the source intensity was not high enough to accelerate in the accelerator, (2) the use of the accelerator would be limited to only polarized-beam physics, that is, proton-proton interaction, and (3) p-p elastic scattering was not the most popular topic in high-energy physics. In fact, within spin physics, (pi)-nucleon physics looked attractive, since the determination of spin and parity of possible (pi)p resonances attracted much attention. To proceed we needed more data beside total cross sections and elastic differential cross sections; measurements of polarization and other parameters were urgently needed. Polarization measurements had traditionally been performed by analyzing the spin of recoil protons. The drawbacks of this technique are: (1) it involves double scattering, resulting in poor accuracy of the data, and (2) a carbon analyzer can only be used for a limited region of energy. DOE

N93-24234# Puerto Rico Univ., Rio Piedras. Dept. of Physics.
THE ROLE OF THE DIPOLE-DIPOLE INTERACTION IN THE SOLVATION OF MONOATOMIC MONOVALENT IONS ON THE BASIS *OF THE MEAN SPHERICAL APPROXIMATION*
W. R. Fawcett and Lesser Blum 15 Jan. 1992 17 p Prepared in cooperation with California Univ., Davis
(Contract N00014-90-J-1263)
(AD-A260284; TR-18) Avail: CASI HC A03/MF A01

The mean spherical approximation is used to study the role of dipole-dipole interactions in the solvation of ions in water. GRA

N93-24251# Sacramento Peak Observatory, Sunspot, NM.
***THE LIQUID CRYSTAL POLARIMETER FOR SOLID-STATE IMAGING* OF SOLAR VECTOR MAGNETIC FIELDS Final Report, 1 Oct. 1988 - 30 Sep. 1992**
Laurence J. November and Lawrence M. Wilkins 28 Sep. 1992 20 p
(AD-A260029; PL-TR-92-2246; AD-E201359) Avail: CASI HC A03/MF A01

The Liquid Crystal Polarimeter (LCP) is a low-voltage complete Stokes polarimeter and spectral analyzer designed for measuring solar vector magnetic fields. The polarimeter consists of polarization and spectral analyzer sections each containing multiple commercially available nematic and ferro-electric liquid crystals that are modulated in phase at up to 31.5 kHz frequency. Used in conjunction with a Lyot birefringent filter and 2 CCD's, the system provides a complete polarization/spectral measurement for solid-state direct imaging of the vector magnetic flux, Doppler velocity, intensity, and line width in a spectral line. Simultaneous 2 CCD imaging gives reduced atmospheric seeing systematics, and automatic CCD gain and dark-current correction. The liquid-crystal design provides a considerable simplification to previous designs with greatly improved speed, sensitivity, reliability, and accuracy. The system is used with a universally tunable Lyot filter (of conventional rotating-element design) to provide sequential observations in a number of solar lines to permit calibration of field strength and measurements as a function of height in the solar atmosphere. An example vector magnetogram is shown as a proof of concept. GRA

N93-24261# Puerto Rico Univ., Rio Piedras. Dept. of Physics.
A SIMPLE MODEL FOR THE DIELECTRIC BEHAVIOUR OF POLAR SOLVENTS IN THE MEAN SPHERICAL APPROXIMATION
Lesser Blum and W. R. Fawcett 15 Jan. 1993 17 p Prepared in cooperation with California Univ., Davis
(Contract N00014-90-J-1263)
(AD-A260283; TR-26) Avail: CASI HC A03/MF A01

A simple model based on the mean spherical approximation is described for the dielectric properties of polar solvents. The molecular properties required are the dipole moment, the molecular polarizability, and the molecular diameter. It is shown that inclusion of a stickiness parameter accounting for other electrostatic features and non-sphericity in the real system leads to a simple analytical result from which the dielectric constant may be calculated. The stickiness parameter is shown to be correlated to the magnitude of dipole-dipole interactions in the system. GRA

N93-24275# Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
COHERENT ANTI-STOKES RAMAN SPECTROSCOPY OF HIGHLY VIBRATIONALLY EXCITED MOLECULES Final Report
Eric Mazur 16 Oct. 1992 21 p
(Contract DAAL03-88-K-0114)
(AD-A260381; ARO-25653.4-PH) Avail: CASI HC A03/MF A01

The thrust of this project was to study the vibrational dynamics of infrared multiphoton excited (IRMPE) molecules in a free supersonic jet expansion using time-resolved broadband coherent anti-Stokes Raman spectroscopy (CARS). The work carried out is an extension of work previously carried out under ARO contract DAAG29-85-K-0060 which expired in February 1988. GRA

N93-24410# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ATOM WAVE INTERFEROMETER Annual Report, 1 Dec. 1991 - 30 Nov. 1992
David E. Pritchard 21 Jan. 1993 4 p
(Contract N00014-89-J-1207)
(AD-A260082) Avail: CASI HC A01/MF A01

Between December 1992 and November 30, 1992, we refined our atom interferometer and started to perform experiments with spatially separated beams. The interferometer is now operating with smaller period gratings, providing greater beam separation. The experiments were performed with the aid of an interaction region that inserts a thin metal foil between the beams. This allowed us to manipulate the atomic wave function in only one arm of the interferometer. The key component of our interferometer is the set of three matched transmission diffraction gratings which we constructed at the National Nanofabrication Facility (NNF) at Cornell University. The process allows fabrication of precisely positioned openings in thin silicon nitride membranes mounted in silicon frames. The pattern created in the membrane is determined by an electron beam writer, making the process quite versatile. GRA

N93-24427# Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
DISTRIBUTION OF TRAPPED ELECTRONS AT INTERFACE STATES IN ACTFEL DEVICES
S. Kobayashi, J. F. Wager, and A. Abu-Dayah 1992 8 p
(Contract DAAL03-91-G-0242)
(AD-A260396; ARO-28852.2-PH) Avail: CASI HC A02/MF A01

The distribution of trapped electrons at interface states in alternating-current thin-film electroluminescent (ACTFEL) devices is assessed using a new field-stimulated charge measurement technique in which the polarization charge transient is measured experimentally and curve fit using a model for the dynamic emission of electrons from interface states. The trapped electron distribution is relatively small at low energy but rises abruptly at approximately 0.6-0.8 eV below the conduction band minimum for an ACTFEL device with SiON insulators. GRA

N93-24448# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Physics.
INVESTIGATIONS IN DYNAMICS OF GAUGE THEORIES IN THEORETICAL PARTICLE PHYSICS
1993 26 p
(Contract DE-FG05-92ER-40709)
(DE93-007260; DOE/ER-40709/1-Task-A) Avail: CASI HC A03/MF A01

The major theme of the theoretical physics research conducted under DOE support over the past several years has been within the rubric of the standard model, and concerned the interplay between symmetries and dynamics. The research was thus carried out mostly in the context of gauge field theories, and usually in the presence of chiral fermions. Dynamical symmetry breaking was examined both from the point of view of perturbation theory, as well as from non-perturbative techniques associated with certain characteristic features of specific theories. Among the topics of research were: the implications of abelian and non-abelian anomalies on the spectrum and possible dynamical symmetry breaking in any theory, topological and conformal properties of quantum fields in two and higher dimensions, the breaking of global chiral symmetries by vector-like gauge theories such as QCD, the phenomenological implications of a strongly interacting Higgs sector in the standard model, and the application of soliton ideas to the physics to be explored at the SSC. DOE

N93-24454# National Inst. of Standards and Technology, Gaithersburg, MD.
NEUTRON CROSS SECTION STANDARDS AND INSTRUMENTATION
1 Sep. 1992 18 p
(Contract DE-AI05-91ER-40610)
(DE93-007675; DOE/ER-40610/T1) Avail: CASI HC A03/MF A01

This report from the National Institute of Standards and Technology contains a summary of the accomplishments of the Neutron Cross Section Standards and Instrumentation Project during the second year of a three-year interagency agreement. This program includes a broad range of data measurements and evaluations. An emphasis has been focused on the (sup 10)B cross sections where serious discrepancies in the nuclear data base remain. In particular, there are important problems with the interpretation of the helium gas production associated with diagnostic measurements of interest in nuclear technology. The enhanced use of this isotope for medical treatment is also of significance. New measurements of neutron reaction cross sections for (sup 10)B are in progress in collaboration with scientists at the Oak Ridge National Laboratory. New experiments are in progress on the important dosimetry standards (sup 237)Np(n,f) and (sup 239)Pu(n,f) below 1 MeV neutron energy. In addition, new measurements of charged-particle production in basic biological elements for medical applications are underway. Further measurements are planned or in progress in collaborations which include fission fragment energy and angular distributions, and neutron energy spectra and angular distributions from neutron-induced fission. Also measurements of angular distributions of neutrons from scattering on protons, and determinations of capture cross section of gold are planned for a later time. Data evaluation will shift to include a unified international effort to motivate new measurements and evaluations. In response to the requests of the measurement community, NIST is beginning the formation of a national depository for fissionable isotope mass standards. This action will preserve for future measurements the valuable and irreplaceable critical samples whose masses and composition have been carefully determined and documented over the past 30 years of the nuclear program. DOE

N93-24467# California Univ., Santa Barbara. Dept. of Physics.
LOW TEMPERATURE TRANSPORT THROUGH A QUANTUM DOT: THE ANDERSON MODEL OUT OF EQUILIBRIUM Technical Report, 1 Jan. - 31 Dec. 1992
Y. Meir, N. Wingreen, and P. Lee Mar. 1993 21 p
(Contract N00014-89-J-1530)
(AD-A260184; TR-42) Avail: CASI HC A03/MF A01

The infinite-U Anderson model is applied to non-equilibrium transport through a quantum dot containing two spin levels weakly coupled to two leads. At low temperatures, the Kondo peak in the equilibrium density of states is split upon the application of a voltage bias. The split peaks, one at the chemical potential of each lead, are suppressed by non-equilibrium dissipation. In a magnetic field, the Kondo peaks shift away from the chemical potentials by the Zeeman energy, leading to an observable peak in the differential conductance when the non-equilibrium bias equals the Zeeman energy. GRA

N93-24510# Virginia Polytechnic Inst. and State Univ., Blacksburg. Inst. for High Energy Physics.
STUDY OF ELECTROWEAK INTERACTIONS
A. Abashian, K. Gotow, L. Piilonen, and N. Morgan 1 Oct. 1992 59 p
(Contract DE-FG05-92ER-40709)
(DE93-007261; DOE/ER-40709/1-Task-B) Avail: CASI HC A04/MF A01

The experimental study of electroweak interactions at Virginia Tech is multifaceted and consists of three parts. The first consists of analysis of

the final states of matter produced in electron-positron annihilations at center-of-mass energies (radical)s = 60 GeV at the TRISTAN collider in Japan (AMY). The second is a sensitive search for rare electroweak processes through a study of mu(+) yields e(+) gamma at the LAMPF facility at Los Alamos (MEGA). It also includes a precise measurement of the Michel (rho) parameter (RHO). The third activity is a R & D detector development and is a precursor to anticipated experiments at proposed B(sup o) meson factories in this country and/or abroad. The physics goals are the study of CP violation in the B(sup 0) system and the determination of the values for Kobayashi-Maskawa matrix. DOE

N93-24565# Lawrence Livermore National Lab., CA.
ATOMIC SCALE STITCHING OF BERYLLIUM COATINGS TO CARBON SUBSTRATES USING 200-keV CARBON IONS
G. R. Wirtenson and R. G. Musket Oct. 1992 11 p
(Contract W-7405-eng-48)
(DE93-007392; UCRL-ID-112186) Avail: CASI HC A03/MF A01

Passage of ions through the interface between a non-reactive film and substrate can dramatically enhance the adhesion of the film to the substrate. When essentially all the energy deposited by the ions at the interface can be accounted for by electronic excitation, the enhancement process has been termed stitching. We have used this phenomenon to enhance the adhesion of 240-nm thick beryllium films to polished, vitreous carbon substrates using 200-keV carbon ions. The adhesion of the as-deposited films was below that necessary to pass the Scotch-tape-test. Carbon ion fluences greater than about 1 x 10(exp 14) C/cm(exp 2) were sufficient to enhance the adhesion enough to ensure passage of the tape test without affecting the optical properties of the films. In addition, the films remained adherent after exposure to a pulse of soft x rays. DOE

N93-22184*# Sverdrup Technology, Inc., Bay Saint Louis, MS.
AN X RAY SCATTER APPROACH FOR NON-DESTRUCTIVE CHEMICAL ANALYSIS OF LOW ATOMIC NUMBERED ELEMENTS
H. Richard Ross In NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 330-339 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-24371# Wien Univ. (Austria). Atominst.
DOSIMIR: RADIATION MEASUREMENTS INSIDE THE SOVIET SPACE STATION MIR, FIRST RESULTS
N. Vana, W. Schoener, M. Fugger, and J. A. Akatov (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 193-197 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

N93-22343# Los Alamos National Lab., NM.
THEORETICAL MODELS OF NEUTRON EMISSION IN FISSION
D. G. Madland 1992 10 p Presented at the Symposium on Nuclear Data Evaluation Methodology, Upton, NY, 12-16 Oct. 1992
(Contract W-7405-eng-36)
(DE93-005482; LA-UR-92-4170; CONF-921046-15) Avail: CASI HC A02/MF A01

A brief survey of theoretical representations of two of the observables in neutron emission in fission is given, namely, the prompt fission neutron spectrum N(E) and the average prompt neutron multiplicity (bar v)(sub p). Early representations of the two observables are presented and their deficiencies are discussed. This is followed by summaries and examples of recent theoretical models for the calculation of these quantities. Emphasis is placed upon the predictability and accuracy of the new models. In particular, the dependencies of N(E) and (bar v)(sub p) upon the fissioning nucleus and its excitation energy are treated. Recent work in the calculation of the prompt fission neutron spectrum matrix N(E,E(sub n)), where E(sub n) is the energy of the neutron inducing fission, is then discussed. Concluding remarks address the current status of our ability to calculate these observables with confidence, the direction of future theoretical efforts, and limitations to current and future calculations. Finally, recommendations are presented as to which model should be used currently and which model should be pursued in future efforts. DOE

N93-22488*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
GREEN'S FUNCTION METHODS IN HEAVY ION SHIELDING
John W. Wilson, Robert C. Costen, Judy L. Shinn, and Francis F. Badavi (Christopher Newport Coll., Newport News, VA.) Mar. 1993 20 p
(RTOP 593-42-21-01)
(NASA-TP-3311; L-17184; NAS 1.60:3311) Avail: CASI HC A03/MF A01

An analytic solution to the heavy ion transport in terms of Green's function is used to generate a highly efficient computer code for space applications. The efficiency of the computer code is accomplished by a nonperturbative technique extending Green's function over the solution domain. The computer code can also be applied to accelerator boundary conditions to allow code validation in laboratory experiments. Author

N93-23324# Texas A&M Univ., College Station. Dept. of Physics.
HIGH ENERGY PHYSICS PROGRAM AT TEXAS A AND M UNIVERSITY
Nov. 1992 183 p
(Contract DE-FG05-91ER-40633)
(DE93-005112; DOE/ER-40633/2) Avail: CASI HC A09/MF A02

The high energy physics program has continued its experimental activities over the past year. In CDF, the Texas A&M group has led an effort to design an upgrade for the silicon vertex detector, and is currently working with the rest of the collaboration on the next major data taking run. In MACRO, work was done on the development of the final version of the wave form digitizing system being implemented for the entire scintillator system. This work is nearing completion, and the system is expected to be up and running on the detector by summer 1993. Work was done within the SDC group to develop gas microstrip chambers for use in precision tracking at the SSC, and in the GEM group, toward the development of a suitable forward calorimeter design. The theoretical high energy physics program has continued the study of a very successful string-derived model that unifies all known interactions: flipped SU(5), which is the leading candidate for a TOE. Work has also continued on some generalizations of the symmetries of string theory, known as W algebras. These are expected to have applications in two-dimensional conformal field theory, two-dimensional extensions of gravity and topological gravity and W-string theory. DOE

N93-24464# Stanford Linear Accelerator Center, CA.
OBSERVATION OF A CHARGE LIMIT FOR PHOTOCATHODE ELECTRON GUNS
M. Woods, J. Clendenin, J. Frisch, A. Kulikov, P. Saez, D. Schultz, J. Turner, K. Witte, and M. Zolotorev Dec. 1992 6 p Presented at the Workshop on Polarized Electron Sources and Electron Spin Polarimeters, Nagoya, Japan, 7-14 Nov. 1992
(Contract DE-AC03-76SF-00515)
(DE93-006948; SU-SLAC-PUB-6019; CONF-9211182-2) Avail: CASI HC A02/MF A01

The Photocathode Electron Gun (PEG) at SLAC is required to produce bunch intensities of up to 10(exp 11) electrons within 2 ns (8 Amps). Operation of PEG has demonstrated a 'Charge Limit' phenomenon, whereby the charge that can be extracted from the gun with an intense laser beam saturates at significantly less than 10(exp 11) electrons (the expected 'Space Charge Limited' charge) when the photocathode Quantum Efficiency is low. We report studies of this Charge Limit phenomenon observed with a GaAs photocathode. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N93-22037* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
OFF-SURFACE INFRARED FLOW VISUALIZATION Patent
Gregory S. Manuel, inventor (to NASA), Clifford J. Obara, inventor (to NASA), Kamran Daryabeigi, inventor (to NASA), and David W. Alderfer, inventor (to NASA) 6 Apr. 1993 4 p Filed 16 Dec. 1991 Supersedes N92-30312 (30 - 21, p 3720)
(NASA-Case-LAR-14568-1; US-Patent-5,200,621;
US-Patent-Appl-SN-808302; US-Patent-Class-250-330;
US-Patent-Class-250-338.5; US-Patent-Class-250-340;
US-Patent-Class-244-204; US-Patent-Class-73-147;
Int-Patent-Class-G01M-19/00; Int-Patent-Class-G01M-9/06) Avail: US Patent and Trademark Office

A method for visualizing off-surface flows is provided. The method consists of releasing a gas with infrared absorbing and emitting characteristics into a fluid flow and imaging the flow with an infrared imaging system. This method allows for visualization of off-surface fluid flow in-flight. The novelty of this method is found in providing an apparatus for flow visualization which is contained within the aircraft so as not to disrupt the airflow around the aircraft, is effective at various speeds and altitudes, and is longer-lasting than previous methods of flow visualization.
Official Gazette of the U.S. Patent and Trademark Office

N93-22039*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TRANSVERSELY POLARIZED SOURCE CLADDING FOR AN OPTICAL FIBER Patent Application
Claudio O. Egalon, inventor (to NASA) (AS&M, Inc., Hampton, VA.) and Robert S. Rogowski, inventor (to NASA) 25 Feb. 1993 16 p
(NASA-Case-LAR-14652-1-SB; NAS 1.71:LAR-14652-1-SB;
US-Patent-Appl-SN-022582) Avail: CASI HC A03/MF A01

An optical fiber comprising a fiber core having a longitudinal symmetry axis is provided. An active cladding surrounds a portion of the fiber core and comprises light-producing sources which emit light in response to chemical or light excitation. The cladding sources are oriented transversely with respect to the longitudinal axis of the fiber core. This polarization results in a superior power efficiency compared to active cladding sources that are randomly polarized or longitudinally polarized parallel with the longitudinal symmetry axis. NASA

N93-22453 National Physical Lab., Teddington (England). Materials Metrology Div.
OPTICAL PROPERTIES OF SLAGS: DATA FOR REFRACTIVE INDICES AND ABSORPTION COEFFICIENTS
M. Susa and K. C. Mills Aug. 1992 37 p
(NPL-DMM(A)-73; ETN-93-93550) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Values of the refractive indices and absorption coefficients of slags and glasses, important in the calculation of the radiation conductivity contribution to heat transfer in slags, are collated and evaluated. The principle methods used to obtain refractive index are outlined: immersion method; Brewster angle method; Pulfrich refractometer; Abbe refractometer; minimum deviation method; and ellipsometry. Factors affecting the refractive indices are discussed: density, composition, wavelength and temperature. Transition methods and reflectance measurements used for determining absorption coefficients are described. Wavelength, temperature and crystallinity factors are outlined. ESA

N93-22506# Pacific Northwest Lab., Richland, WA.
THE PNL HIGH-TRANSMISSION THREE-STAGE MASS SPECTROMETER
J. J. Stoffels, D. R. Ells, L. A. Bond, P. A. Freedman, B. N. Tattersall (VG Isotech, Middlewich, England.), and C. R. Lagergren (Westinghouse Hanford Co., Richland, WA.) Dec. 1992 36 p
(Contract DE-AC06-76RL-01830)
(DE93-006143; PNL-8456) Avail: CASI HC A03/MF A01

We have constructed a three-stage isotope-ratio mass spectrometer of unique ion-optical design that achieves high ion transmission efficiency and high abundance sensitivity. The spectrometer has tandem 90 deg deflection magnets with boundaries 18 deg off normal. The magnet drift lengths are 1.48 times the 27-cm radius of deflection. This extended geometry gives a mass dispersion equivalent to a 40-cm-radius magnet with normal boundaries. The first magnet renders the ion beam parallel in the vertical plane and provides a focus in the horizontal plane of mass dispersion. The second magnet brings the beam to a stigmatic focus. This novel ion-optical design gives 100 percent transmission without the need for intermediate focusing lenses. It also provides a 16 percent increase in mass resolution over the traditional tandem geometry with normal magnet boundaries. Complete transmission of ions is maintained through a third-stage cylindrical electric sector of 38-cm radius, which provides increased isotope-abundance sensitivity. The isotope-abundance sensitivity of the new mass spectrometer is an order of magnitude better than similar instruments with normal magnet boundaries. This is because the vertical focusing of the ion beam prevents ion scattering from the top and bottom of the flight tube. The measured values of the isotope-abundance sensitivity one-half mass unit away from the rhenium ion peaks at masses 185 and 187 are M - 1/2 = (6.5 +/- 0.5)(10)(exp -10) and M + 1/2 = (3.1 +/- 0.8)(10)(exp -10). By extrapolation, the uranium isotope-abundance sensitivity is M - 1 = 1(10)(exp -10). Construction of the instrument was facilitated by using standard commercial mass spectrometer components. DOE

N93-22762# Oak Ridge National Lab., TN.
PASSIVE (SELF-POWERED) FIBER-OPTIC SENSORS
S. A. McElhaney, D. D. Falter, R. A. Todd, M. L. Simpson, and J. T. Mihalczo 1992 4 p Presented at the IEEE Meeting, Orlando, FL, 26-30 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005761; CONF-9210232-5) Avail: CASI HC A01/MF A01

ORNL is developing a new group of fiber-optic sensors for characterizing physical aspects such as ambient temperature. These sensors exploit the inherent property of thermographic materials that the lifetime and/or intensity of the emitted fluorescence decreases with increasing temperature. Unlike current fluorescent temperature sensors that use a light source for excitation, these sensors are totally passive (self-powered) and use either an embedded or external radiation source. A proof-of-principle temperature sensor was developed, based on this concept, using a well-known thermographic material, magnesium fluorogermanate. Experimental results showed that the radiation-induced fluorescence resulted in an intensity change but no significant decay rate change with increasing temperature. DOE

N93-22941# Sandia National Labs., Albuquerque, NM.
THE EFFECT OF UV LIGHT ON Ir ABSORPTION IN CHEMICALLY VAPOR DEPOSITED a-SIN(x):H FILMS
C. H. Seager and J. Kanicki (International Business Machines Corp., Yorktown Heights, NY.) 1992 5 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-004502; SAND-92-1520C; CONF-921101-18) Avail: CASI HC A01/MF A01

The optical absorption properties of Plasma Enhanced Chemically Vapor Deposited (PECVD) films of hydrogenated amorphous silicon nitride (a-SiN(x):H) over the energy range from 0.54 to 2 eV using Photothermal Deflection Spectroscopy (PDS) were measured. The near-infrared absorption properties of these films measure the H bonded to Si or N as well as density of electronic gap states due to species like Si dangling bonds. Typical PDS spectra obtained on as-deposited films show a broad absorption tail with a large number of narrow absorption peaks. Nitride-related absorption was separated from that arising from the fused quartz substrates. In addition to the broad, featureless band tail, whose magnitude is quite sensitive to optical excitation with light above approximately 3.9 eV, a number of narrow absorption peaks are observed which are identified as overtones of localized vibrational modes. Specifically, peaks at 0.82 and 1.20 eVare seen which are identified as the first and second harmonics of N-H stretching vibrations, and several other peaks whose origins remain undetermined. Prolonged UV excitation produces no detectable change in these vibrational modes, although large changes are seen in the underlying absorption tail. This reinforces previous suggestions that photoinduced changes in these films do not arise from rearrangement of the bonded hydrogen. DOE

N93-22948# North Carolina Agricultural and Technical State Univ., Greensboro.
STIMULATED BRILLOUIN SCATTERING SWITCHING IN MID FIBERS Final Report, 1 Jan. 1988 - 15 Aug. 1992
Chung Yu Oct. 1992 70 p LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(Contract DAAL03-88-G-0005)
(AD-A260456; ARO-25197.1-EH-H) Avail: CASI HC A04/MF A01

A brief outline of research findings plus a description of the experimental design, a discussion of switching of optical signal by Stimulated Brillouin scattering single-mode optical fibers and a preliminary study of fiber ring for enhancement of SBS generation in mid IR Fiber are presented. GRA

N93-22961*# Hughes Danbury Optical Systems, Inc., CT.
LUTE PRIMARY MIRROR MATERIALS AND DESIGN STUDY REPORT
Greg Ruthven Feb. 1993 100 p
(NASA Order H-11994-D)
(NASA-CR-192487; NAS 1.26:192487; PR-D15-0013A) Avail: CASI HC A05/MF A02

The major objective of the Lunar Ultraviolet Telescope Experiment (LUTE) Primary Mirror Materials and Design Study is to investigate the feasibility of the LUTE telescope primary mirror. A systematic approach to accomplish this key goal was taken by first understanding the optical, thermal, and structural requirements and then deriving the critical primary mirror-level requirements for ground testing, launch, and lunar operations. After summarizing the results in those requirements which drove the selection of material and the design for the primary mirror are discussed. Most important of these are the optical design which was assumed to be the MSFC baseline (i.e. 3 mirror optical system), telescope wavefront error (WFE) allocations, the telescope weight budget, and the LUTE operational temperature ranges. Mechanical load levels, reflectance and microroughness issues, and options for the LUTE metering structure were discussed and an outline for the LUTE telescope sub-system design specification was initiated. The primary mirror analysis and results are presented. The six material substrate candidates are discussed and four distinct mirror geometries which are considered are shown. With these materials and configurations together with varying the location of the mirror support points, a total of 42 possible primary mirror designs resulted. The polishability of each substrate candidate was investigated and a usage history of 0.5 meter and larger precision cryogenic mirrors (the operational low end LUTE temperature of 60 K is the reason we feel a survey of cryogenic mirrors is appropriate) that were flown or tested are presented. Derived from text

N93-23465# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
A VECTOR SIGNAL PROCESSING APPROACH TO COLOR M.S. Thesis
Kah-Kay Sung Jan. 1992 146 p
(Contracts N00014-89-J-3139; N00014-91-J-4038; NSF MIP-88-14612)
(AD-A259499; AI-M-1349) Avail: CASI HC A07/MF A02

Color is a useful visual cue for obtaining surface material information in a scene. Unfortunately, the surface color of an object can sometimes be different from its recorded color in an image because of optical effects like highlight and inter-body reflection. These effects often confuse traditional color algorithms that assume all surfaces in a scene to be perfectly lambertian. This thesis adopts a signal processing approach to color vision. It represents surface color as a vector signal in a 3-dimensional color space, from which we extract region and boundary information. We immediately face two problems with this approach. The first, which is the same problem that traditional color algorithms face, is that highlight and inter-body reflection effects make image color different from surface color. We use a simple but effective method based on the theory of polarizing filters and electromagnetic wave reflection to correct for these effects on dielectric material surfaces in the scene. The second problem is to augment traditional scalar signal processing tools for 3-dimensional color vector signals. We linearize color by defining a notion of color similarity and difference, and use these measures in place of their traditional scalar counterparts in our vector signal processing algorithms. The main contribution of this thesis is the systematic approach we propose that allows us to extend scalar signal processing tools and concepts into a multi-dimensional vector domain. We also discuss some ways of integrating surface color information with grey level intensity information. GRA

N93-23469# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
OPTIMAL THREE-DIMENSIONAL MATCHED FILTER PROCESSING FOR DETECTION OF POINT-LIKE MOVING OBJECTS IN CLUTTER
John N. Sanders 30 Sep. 1992 59 p
(Contract F19628-90-C-0002)
(AD-A259727; TR-946; ESD-TR-91-244) Avail: CASI HC A04/MF A01

A simple model of a time sequence of star images containing a moving point object (satellite) is developed. Optimal signal enhancement and detection processing theory is applied to this model and a three-dimensional Fourier matched filter implementation is derived to compute clutter-to-noise ratio (CNR) suppression, signal-to-noise ratio (SNR) enhancement, and probability of detection (Pd) and false alarm (Pfa) rate estimates as a function of input single pixel SNR. Using this theory allows one to compute the Fourier domain matched filters directly, thereby eliminating the enormous storage cost associated with large banks of three-dimensional matched filters. The model and theory are tested using computer-generated simulated data sets having known noise and clutter characteristics. The theory is then applied to real data sets collected using a Lincoln Laboratory CCD camera. Initial results indicate good agreement with matched filter theory. Detection of objects with an initial single pixel SNR approximately equal to 1 is demonstrated. GRA

N93-23499 Open Univ., Oxford (England).
SPHERICAL WAVE REFLECTION AND TRANSMISSION Ph.D. Thesis
Yu Chen 1992 208 p
Avail: Univ. Microfilms Order No. BRDX97161

This study is concerned with the reflection and transmission of spherical waves at a plane interface between two different media. The phenomenon of the reflection and transmission of spherical waves have been studied by means of analytical methods, numerical computation, and experimental tests. A new integral representation for a spherical wave is obtained by transforming Lamb/Sommerfeld's integral representation. The new integral has no singularity so it allows more accurate numerical integration. A new proof of Lamb/Sommerfeld's integral representation for a spherical wave is presented based on the new integral. By using the new form of solutions for reflected waves and existing solutions for transmitted waves, numerical studies have been carried out to examine the phenomenon of reflection and transmission of spherical waves at plane surfaces of discontinuity in material properties. It is shown that the effective critical angle for the total reflection of a spherical wave is greater than that of a plane wave at a hard boundary, and that when the source height increases the effective critical angle for the total reflection of a spherical wave tends to that of a plane wave. It is shown that recent predictions of spherical wave reflection and transmission coefficients greater than 1 at normal incidence under certain conditions are probably due to numerical integration error. It also has been found that for spherical wave reflection and transmission, the time average energy flux, normal to a plane parallel to the plane of discontinuity, may locally be in the direction opposite to that of the direction of energy transmission over the plane as a whole. This so-called 'backward wave' occurs in an interference between the direct and reflected waves, as well as in a transmitted wave. An indirect test on the theory has been performed to check the pressure field, above a rigid boundary, predicted by the spherical wave theory. Theoretical and experimental results were in good agreement. Dissert. Abstr.

N93-23639# Rockwell International Corp., Thousand Oaks, CA.
ACTIVE MICROPARTICLE MEDIA Final Report, 25 Sep. 1987 - 13 Jan. 1991
T. P. Shen Sep. 1992 152 p
(Contract F29601-87-C-0050)
(AD-A259722; AD-E201268; PL-TR-91-1020) Avail: CASI HC A08/MF A02

The theoretical and experimental research on the active nonlinear optical processes in the microparticle composites and conjugated polymers were investigated. The experimental studies focused on the transient effects in the phase conjugation and coherent beam combination using picosecond pulses. The theoretical studies emphasized the physical mechanisms of the nonlinear properties of the metallic microparticle composites and the conjugated polymers. Solid-state nonlocal continuum for the nonlinear electrodynamics of the microparticle composites was developed. A semiclassical lattice-dynamic theory was derived to predict the large nonresonant optical nonlinearity below the bandgap for one-dimensional

conjugated polymers. This effort concentrated on the electronic nonlinearity of the microparticle composites and the conjugated polymers. The electronic nonlinearity is the most significant contribution for the picosecond pulse applications, which are useful in the high bit-rate transmission and communication. GRA

N93-23645# Illinois Univ., Urbana. Dept. of Physics.
ELECTROLYTE ELECTROREFLECTANCE AND AUTOMATIC SCANNING ELLIPSOMETRY CHARACTERIZATION OF MERCURY CADMIUM TELLURIDE Final Report, 1 Feb. 1983 - 31 Jan. 1986
Paul M. Raccah 7 Jul. 1992 58 p
(Contract DAAK70-83-K-0047; DA Proj. 1L1-61102-A-31-B)
(AD-A260043; NV-90-15) Avail: CASI HC A04/MF A01

The optical characterization of bulk, epitaxial, and surface treated, e.g. oxidized, mercury cadmium telluride by electrolyte electroreflectance, automatic scanning ellipsometry, and reflectance were experimentally and theoretically unified to establish a basis for in situ nondestructive evaluation of composition, crystal quality, and surface and interface properties. Specifically, a generalized theory was developed and applied to yield a unified interpretation of experimental E1 transition energies and line widths and anomalies for the consistent determination of composition fraction, x-value, relative crystal quality, interface roughness, long range strain, and polarizability. GRA

N93-23662# American Chemical Society, Washington, DC.
ORGANIC OPTOELECTRONIC MATERIALS: A TOPICAL WORKSHOP
1992 45 p Workshop held in Monterey, CA, 31 Mar. - 3 Apr. 1992
(AD-A259695) Avail: CASI HC A03/MF A01

The topics covered include the following: Introduction to Nonlinear Optics of Organics and the Use of Second Harmonic Generation as a Polymer Probe; Experimental Characterization of Second Order Nonlinear Optical Chromophores; Chi(2) Structure-Property Relationship on the Colligative Scale; The Stability of the Poled Order in Crosslinked Systems; Corona Electric Filed Poling of Nonlinear Polymers and Femtosecond Optical Applications; Synthesis and Characterization of Photosensitive Polymers for Optical Waveguide Definition; Light-Emitting Diodes Based on Conjugated Polymers; The Relationship Between Chemical Structure and Second-Order Optical Nonlinearities or Organic Molecules; Theory and Structure/Property of chi(3) Materials; Synthesis of Well-Defined Thiophene Oligomers and Planar Conjugated Polymers for chi(3) Studies; and Spectroscopy as a Probe of chi(3) in Conjugated Materials. GRA

N93-23696# Pennsylvania Univ., Philadelphia. Dept. of Bioengineering.
MULTIDIMENSIONAL SIGNAL CODING IN THE VISUAL SYSTEM Annual Report No. 2, 1 Nov. 1991 - 31 Oct. 1992
Gershon Buchsbaum 23 Nov. 1992 8 p
(Grant AF-AFOSR-0082-91)
(AD-A259836; AFOSR-92-1004TR) Avail: CASI HC A02/MF A01

The aims of this research are (1) To study the multidimensional spatio-temporo-chromatic signal processing capabilities of visual receptive fields. (2) To identify the key attributes of multidimensional image signals which are sensitive to receptive field filters and how these attributes are transformed for encoding beyond the receptive fields. By using digitized sequences of natural images, formulating a representation for natural images, and incorporating properties of specialized visual receptive fields and neural pathways we (1) Propose a model of how the early visual system efficiently codes natural time varying images, first by tracking part of the image, then by matching the spatiotemporal properties of the neural pathway to those of the tracked image. We also propose that retinal architecture which varies with eccentricity also matches the properties of the tracked image. (2) Develop a new model for signal propagation through multiple cell layers in the retina which can incorporate the different cell densities in retinal cell layers. (3) Propose that visual color receptive fields are matched to the spatio-chromatic structure of natural color images. GRA

N93-23702# Battelle Memorial Inst., Columbus, OH.
OPTICAL ANALYSIS OF LENSLET ARRAYS Final Report, 22 Dec. 1988 - 31 Oct. 1991
John P. Kurmer, Wolf P. Altman, John S. Laudo, Daniel R. Grieser, and Jane F. OLoughlin Dec. 1992 85 p
(Contract DAAK60-89-C-0010)
(AD-A260126; NATICK-TR-93/011) Avail: CASI HC A05/MF A01

Designs were developed of arrays of small-diameter (2-4 mm) unity-power telescopes to be used with nonlinear optical materials in the protection of the eyes against tunable lasers. A ray-tracing program (Super-Oslo(TM)) was used to design lenslets and predict the performance of four-lens telescopes (quads). Lens types adjudged most promising were aspheres, curved graded-index (GRIM) and kinoform (diffractive) combined with spherical. Variables included lenslet diameter, f-number, quad length, and optical gain. Packing configurations utilized square, round, and hexagonal quads. Properties evaluated included resolution, field of view, aberrations, tolerances, and overall usefulness as components in compact, lightweight goggle elements. Commercial arrays of lenslets were evaluated and found unacceptable. Bi-aspheric lenslets were designed and injection-molded. Lenses from the first supplier were unacceptable, but high-quality lenses were obtained from a second source. An array of 76 lenslet elements, constructed for evaluation of visual characteristics, showed fair optical quality. GRA

N93-24000 Oxford Univ. (England).
TOWARDS INFRARED IMAGE UNDERSTANDING Ph.D. Thesis
Peter Foulkes 1991 242 p
Avail: Univ. Microfilms Order No. BRD-97292

An extensive literature survey has revealed that the majority of previous work in infrared image processing ha ignored the processes leading to the formation of infrared images. Processing has normally either been restricted to simple low-level image enhancement convolutions or has consisted of algorithms copied from computer vision without regard for the inherent differences between infrared and visible images. In this thesis, we address the problem of infrared image formation and derive an irradiance equation for simple infrared scenes. We consider the complications caused by mutual illumination of one or more bodies and indicate how the infrared irradiance equation can also be specified for more complex scenes. The infrared irradiance equation we derive is solved in closed form for some simple geometries for both Lambertian and non-Lambertian surfaces. An infrared imager has been built and is described. Images taken with the imager of a variety of scene geometries show that the experimental results compare favorably with the theoretically derived equations, indicating the validity of the theoretical analysis. We describe how a knowledge of the formation of infrared images can be used to predict the image irradiance pattern of a particular object. We also show how, with a knowledge of the radiance properties and surface geometry of the object, it is possible to detect instances of that object in a scene. Examples are given of successful object detection based on an understanding of the image irradiance. We present a brief history of infrared imagers and a description of the principles on which modern infrared imagers are based. In addition to the survey of the literature published on infrared image processing, a brief summary of some techniques from the computer vision literature and their suitability to infrared image processing is given. A selection of vision techniques are applied to both infrared and visible images to verify conclusions reached in the thesis. Dissert. Abstr.

N93-24054# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
APPARENT OPACITY AFFECTS PERCEPTION OF STRUCTURE FROM MOTION
Daniel Kersten and Heirich Buhlthoff Jan. 1992 7 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124)
(AD-A260099; AI-M-1285; CBIP-34) Avail: CASI HC A02/MF A01

It is well known that the human visual system can reconstruct depth from simple random-dot displays given motion information. This fact has lent support to the notion that structure from stereo and motion systems rely on low-level primitives or tokens, such as edges, derived from image intensities. In contrast, the judgment of surface attributes such as transparency or opacity is often considered to be a higher-level visual process that would make use of low-level stereo or motion information, and perhaps attention or later recognition to tease apart the transparent from the opaque parts. This is exemplified by the lack of computational studies dealing with transparency, compared with the at least limited success of a number of algorithms to solve structure from motion or stereo. In this study, we describe a new illusion and some results that question the above view by showing that depth from transparency and opacity can override the rigidity bias in perceiving depth from motion. This provides

support for the idea that the brain's computation of the surface material attribute of transparency may have to be done either before, or in parallel with the computation of structure from motion. GRA

N93-24156# Department of the Navy, Washington, DC.
FIBER OPTIC INTERFEROMETER CONFIGURATION WITH PUMP-INDUCED PHASE CARRIER Patent Application
Alan D. Kersey, inventor (to Navy) and Carl A. Villarruel, inventor (to Navy) 1 May 1992 21 p
(AD-D015617; US-Patent-Appl-SN-693496; Navy-Case-74137) Avail: CASI HC A03/MF A01

An interferometric fiber optic sensor and method are provided for controlling the optical phase of a fiber interferometer by an optically induced change in the refractive index for one arm of the fiber interferometer and providing a passive all-optical phase shift interrogation in response to this dependency on the optically induced change in the refractive index. The interferometric fiber optic sensor includes a laser source for generating light at a first predetermined wavelength, a fiber interferometer coupled to the laser source and having first and second fiber arms with a predetermined optical path difference between the fiber arms, a predetermined one of the first and second fiber arms being doped with an element for introducing an optically adjustable absorption spectrum, and a pump laser coupled to the predetermined fiber arm for generating light at a second predetermined wavelength so that an effective index for a guided mode in the predetermined fiber arm and a phase delay of the light passing through the fiber interferometer are changed. As a result, the interferometric fiber optic sensor and method allows the phase interrogation of the fiber interferometer by using a passive all-optical approach based on a pump induced refractive index change in the doped fiber arm so that balanced all fiber interferometer elements are used as sensors for eliminating laser induced phase noise. GRA

N93-24189 Maryland Univ., College Park.
THE OPTICAL DESIGN OF THE SPECTROCORONAGRAPH: AN ULTRAVIOLET CORONAGRAPH PAYLOAD FOR A SOUNDING ROCKET PLATFORM Ph.D. Thesis
Clarence Marinus Korendyke 1992 206 p
Avail: Univ. Microfilms Order No. DA9234596

The spectrocoronagraph was specifically designed to observe the solar corona utilizing the relatively unexplored near-UV emission lines present above the solar limb. These lines were first observed by the Naval Research Laboratory Skylab spectrograph and are relatively bright with respect to the solar disk. They contain a number of useful plasma temperature and density diagnostics. The instrument allows a large number of high spatial resolution (less than 1 arc-second), narrow band-width (approximately 0.1 A), two dimensional coronal images in these emission lines to be obtained during a single sounding rocket flight. These observations will yield valuable information on the dominant physical processes present in the inner corona. The spectrocoronagraph consists of a low stray light telescope followed by an imaging spectrograph. The telescope and spectrograph designs incorporate new features to enhance their performance. The coronagraph telescope design includes a Lyot stop and an occulter to reduce instrument stray light levels. The nontraditional choice of a mirror objective allows a compact design with superb solar rejection, no chromatic aberration and excellent imaging properties. The focal plane package utilizes a Fabry-Perot (FP) interferometer in series with a grating spectrograph to produce a channelled spectrum consisting of a series of two dimensional, narrow bandwidth images at the instrument focal plane. All significant optical performance issues have been examined and resolved. The optical performance of near-UV FP interferometer coatings was investigated and found to be sufficient for this application. Measurements of visible and near-UV scattered light from two super-polished mirrors were obtained. The visible measurements showed that the near specular scattered light from these mirrors was equivalent to or better than scattered light from coronagraph quality lenses and mirrors described in the literature. The scattered disk radiation originating at the mirror objective was predicted from the near-UV measurements and compared favorably with coronal intensities at the focal plane. Dissert. Abstr.

N93-24197# City Coll. of the City Univ. of New York, NY.
QUASI-BINARY DECISION MAKING USING LIGHT SCATTERING
P. Hu and M. Lax 1993 10 p
(Contract DAAL03-89-K-0065)
(AD-A260470; ARO-25872.17-PH-SAH) Avail: CASI HC A02/MF A01

Inversion of light scattering by a single spherical scatterer with or without a layered structure is studied. By numerical simulation of the statistical properties of experiments, we can select those angles that will maximize the ability of the experiment to resolve a sphere from a layered scatterer. Applying statistical decision theory, we obtain a criterion for decision making that minimizes the probability of incorrect guesses. GRA

N93-24231# Department of the Navy, Washington, DC.
LOW-DAMAGE MULTILAYER MIRROR FOR THE SOFT X RAY REGION Patent Application
John F. Seely, inventor (to Navy) 30 Sep. 1992 33 p
(AD-D015621; US-Patent-Appl-SN-953697; Navy-Case-73911) Avail: CASI HC A03/MF A01

A mirror for reflecting radiation at a desired wavelength in the soft x-ray region, comprises a substrate and a coating on the substrate. The coating contains a first section and a second section. The first section comprises at least one layer made up of at least a spacer sublayer and a nodal sublayer. The optical thickness of each spacer sublayer is selected so that, upon application of the radiation of desired wavelength, the mirror generates a standing wave having a node in the middle of each nodal sublayer. The second section is disposed between the first section and the substrate, and comprises a plurality of optically absorptive layers. GRA

N93-24240# City Univ. of New York, NY. Center for Large Scale Computation.
APPLICATION AND DEVELOPMENT OF WAVELET ANALYSIS Final Report, 15 Aug. 1990 - 15 Aug. 1992
Richard Tolimieri 15 Aug. 1992 30 p
(Grant AF-AFOSR-0346-90; DARPA Order 6674)
(AD-A260389; AFOSR-93-0021TR) Avail: CASI HC A03/MF A01

We have attacked the problem of designing efficient time-frequency computational tools by the following methods: developing selection procedures which shape an analyzing signal from a priori and precomputed front-end computations on input data based on the Zak transform and ambiguity function; and implementing and comparing code for computing Gabor coefficients. This code uses fast FFT algorithms developed under a DARPA contract. We have determined that the algorithm based on a deconvolution formula produces the fastest code and have applied this code using the one-sided exponential window to transient signal detection. Additionally, we developed a new algorithm for computing classical Gabor coefficients based on the concept of a generalized biorthogonal. This algorithm delays the effects of zero theorem and provides for numerically stable computation of Gabor coefficients locally around known Gabor coefficients. Finally, we developed the proper form of finite discrete Gabor transform by periodizing and sampling. We have applied these results to Gabor representational schemes for submicron filtering, image reconstruction, and image transfer for application to submicron lithography and to designing and constructing optical devices to implement time-frequency representations and to carry out processing on such representations including transient signal detection. GRA

N93-24244# Arizona Univ., Tucson. Dept. of Mathematics.
NONLINEAR OPTICS AND TURBULENCE Final Report, 1 Dec. 1989 - 30 Nov. 1992
Alan C. Newell Oct. 1992 26 p
(Grant AF-AFOSR-0021-90)
(AD-A259950; AFOSR-93-0013TR) Avail: CASI HC A03/MF A01

The ongoing and primary goal of the research is the pursuit of understanding of nonlinear processes in natural phenomena arising in optics and fluids. A considerable share of our attention is devoted to nonlinear optics, a relatively young subject, extremely rich in scientific and technological potential. While the studies focus on scientific questions connected with laser diode arrays, beam instabilities and the behavior of light beams at interfaces between nonlinear dielectrics, the technological ramifications and future opportunities are in many cases obvious. Optics also serves as a useful paradigm for gaining an increased understanding in other fields. For example, turbulence in optics, the study of the complex space-time filaments, patterns and defects which appear in feedback cavities and

counterpropagating beams may be more analytically tractable than in other branches of continuous mechanics. There is little doubt that nonlinear optics is a subject in which interest is increasing. GRA

N93-24260# California Univ., Davis. Div. of Computer Science.
INTELLIGENT, INTEGRATED FIBER OPTIC NETWORKS Final Report, 1 Mar. 1989 - 31 Aug. 1992
Biswanath Mukherjee 29 Oct. 1992 7 p
(Grant AF-AFOSR-0292-89)
(AD-A260282; AFOSR-TR-93-0011) Avail: CASI HC A02/MF A01

The main focus of this project was on high-speed fiber-optic local and metropolitan area networks (LAN's/MAN's) which cover larger distances than traditional LAN's, are implemented in fiber, and operated at high data rates (100 Mbps - 1 Gbps range). Considerable progress was made on the investigation of new medium access control techniques which can not only provide good delay and throughput characteristics, but also provide fairness, support scalability, and accommodate integrated services. Research on the next generation of local networks (referred to as local lightwave networks) was also initiated, with the goal being to exploit the huge electro-optic bandwidth mismatch by employing innovative parallelism and concurrency mechanisms, viz. wavelength division multiplexing (WDM). Progress was made on the development of new architectures and protocols suitable for lightwave technology. GRA

N93-24267# Clarkson Univ., Potsdam, NY. Dept. of Electrical and Computer Engineering.
COMPUTATION OF NONLINEAR OPTICAL SCATTERING BY DROPLETS Final Report, 11 Jun. 1990 - 30 Sep. 1992
Steven C. Hill and Peter W. Harber Nov. 1992 10 p Prepared in cooperation with New Mexico State Univ., Las Cruces
(Contract DAAL03-90-G-0143)
(AD-A260333; ARO-26962.8-GS) Avail: CASI HC A02/MF A01

Researchers developed techniques required for a more thorough analysis of nonlinear optics in droplets and developed models for some nonlinear processes. Techniques for modeling the resonances of perturbed spheres, based primarily on perturbation methods, were continuing to be developed. Falling droplets deviate from perfect sphericity, and laser beams can induce inhomogeneities in the droplets. The techniques developed for perturbed spheres now allow us to model dispersive and absorptive optical bistability in droplets. Linear time-dependent internal fields in droplets illuminated with laser pulses were modeled as a prelude to analyzing the nonlinear optical effects usually observed with pulsed laser illumination. Techniques for computing the internal and scattered fields of droplets illuminated with Gaussian beams were developed. Since droplets are often illuminated with Gaussian beams which may be focused on or outside the droplets, this capability is needed for a thorough modeling of nonlinear optics in droplets. GRA

N93-24641# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany). Inst. fuer Technische Thermodynamik.
DETERMINATION OF THE OPTICAL PROPERTIES OF PARTICLES FOR SOLAR HEATED FLUIDIZED BEDS Ph.D. Thesis - Karlsruhe Univ. [BESTIMMUNG DER OPTISCHEN EIGENSCHAFTEN VON PARTIKELN FUR SOLARBEHEIZTE WIRBELSCHICHTEN]
Christian Sasse May 1992 122 p In GERMAN
(DLR-FB-92-15; ETN-93-93574) Avail: CASI HC A06/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The optical properties of irregularly shaped particles of size ranges from 10 to 300 micrometers are determined in order to calculate the absorptance of a solar heated fludized bed. An experimental numeric procedure is developed in order to predict the radiative transfer in a fludized bed without prior knowledge of the complex refractive index. The absorptance and scattering in solar heated circulating fluidized beds is calculated with the one dimensional radiative transfer equation, assuming a azimuthal symmetry. The input parameters of the radiative transfer equation are the albedo and the phase function of the single particle. These parameters are determined through two individual measurement techniques in combination with a simplified radiative transfer model, the two flux model. The procedure is used to determine the absorptance of gas particle mixtures, for example air with SiC, C, and oil shale. ESA

N93-24646# Norwegian Defence Research Establishment, Kjeller.
THE DETECTION AND AMPLIFICATION PROCESSES IN LOW LIGHT LEVEL CAMERAS WITH CCD AND IMAGE INTENSIFIER
Johannes Soelhusvik 11 Jun. 1992 88 p In NORWEGIAN
(FFI-92/7017; ETN-93-93569) Avail: CASI HC A05/MF A01

The various physical and electronic processes that take place inside a 2nd or 3rd generation Intensified Charge Coupled Device (ICCD) camera were studied mathematically, thus providing a means of simulating the output from the camera. The ICCD camera is used in low light level imaging and is based on combining the high sensitivity of proximity focussed image intensifiers with the versatile CCD sensor for converting the output from the image intensifier into an electronic video signal. Starting with typical scene illumination levels, and the collection of radiation (photons) by the lens, all the detection, amplification, and noise mechanisms that take place inside the image intensifier and the CCD were modeled. ESA

N93-22020# British Aerospace Systems and Equipment Ltd., Plymouth (England).
ADVANCES IN AUTOMATIC ELECTRO-OPTICAL TRACKING SYSTEMS
Anthony J. E. Moy and Andrew D. Hughes *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 12 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A03/MF A02

N93-22025# Prins Maurits Lab. TNO, Rijswijk (Netherlands).
SYSTEM EVALUATION OF A FIBER OPTIC GUIDED MISSILE WITH A SIMPLE GUIDANCE ADDITION TO IMPROVE SYSTEM EFFECTIVENESS
A. J. Krabbendam *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 12 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A03/MF A02

N93-22026# Naval Air Warfare Center, China Lake, CA. Weapons Div.
LINEAR PAYOUT SYSTEMS FOR DISPENSING FIBER-OPTIC DATA LINKS FROM PRECISION-GUIDED MUNITIONS OR HIGH-PERFORMANCE AIRCRAFT/MISSLES
F. Hoban and D. Harms *In* AGARD, Advances in Guidance and Control of Precision Guided Weapons Nov. 1992 5 p (For primary document see N93-22018 08-31)
Copyright Avail: CASI HC A01/MF A02

N93-22232*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A STRONGLY GOAL-DIRECTED CLOSE-RANGE VISION SYSTEM FOR SPACECRAFT DOCKING Abstract Only
Kim L. Boyer (Ohio State Univ., Columbus.) and Ralph E. Goddard *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 3 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22240*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AUTOMATED TARGET RECOGNITION AND TRACKING USING AN OPTICAL PATTERN RECOGNITION NEURAL NETWORK Abstract Only
Tien-Hsin Chao *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22273*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OPTICAL CORRELATORS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only
Richard Juday *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. A Compilation of the Abstracts 1991 2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

N93-22290*# Lockheed Missiles and Space Co., Palo Alto, CA.
OPTICAL PHASE MEASURING SENSORS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only
Wayne Metheny and Mark Malin *In* NASA, Washington, NASA Automated

Rendezvous and Capture Review. A Compilation of the Abstracts 1991
2 p (For primary document see N93-22226 08-12)
Avail: CASI HC A01/MF A03

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N93-22052# Science Applications International Corp., San Diego, CA.
SALIENT ISSUES OF EDGE PHYSICS PERTAINING TO LOSS OF CONFINEMENT: A RESISTIVE MHD ANALYSIS
D. R. Thayer 23 Apr. 1992 4 p
(Contract DE-FG03-90ER-54071)
(DE93-006123; DOE/ER-54071/T3) Avail: CASI HC A01/MF A01

Contributions were made towards the ultimate goal of creating a complete theory of edge turbulence and transport in magnetic fusion devices. The main focus was to utilize a resistive magnetohydrodynamic (MHD) model. This analysis includes: (1) 'rippling' type models in which the current fluctuations are decoupled and the resistivity fluctuations are fundamental, and (2) 'drift' type models in which the ambient current can be small (no resistivity fluctuations needed) and the current fluctuations are fundamental. In these turbulence frameworks, the important atomic physics based edge sources were included (impurity radiation, ionization, and charge exchange effects). DOE

N93-22053# Science Applications International Corp., San Diego, CA.
THERMALLY DRIVEN TURBULENCE AND TRANSPORT IN A SHEARED SYSTEM
D. R. Thayer and P. H. Diamond (California Univ., San Diego.) 1992
18 p
(Contracts DE-FG03-90ER-54071; DE-FG03-88ER-53275)
(DE93-006125; DOE/ER-54071/T5) Avail: CASI HC A03/MF A01

Results from a theory of radiatively enhanced tokamak edge turbulent transport are presented. A serious restriction on the impurity radiation drive is identified. In particular, due to a lack of pressure balance near a rational surface, the condensation effect does not survive. Consequently, the thermal instability drive is the only impurity radiation instability which remains. Our analysis consists of a theoretical calculation for the thermally driven drift-rippling mode model (phi, eta, Tau, nu(sub parallel)). Calculations of the edge fluctuations and the resultant transport coefficients versus radius are presented. DOE

N93-22065# Argonne National Lab., IL.
SIMULATION OF A PARTICLE-LADEN COMBUSTION FLOW IN AN MHD SECOND STAGE COMBUSTOR
S. L. Chang and S. A. Lottes 1992 19 p Presented at the Winter Annual Meeting of the ASME, Anaheim, CA, 8-13 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-004244; ANL/CP-75323; CONF-921110-41) Avail: CASI HC A03/MF A01

An Argonne two-phase combustion flow computer code is used to simulate reacting flows to aid the development of an advanced combustor for magnetohydrodynamic power generation. The combustion code is a general hydrodynamics computer code for two-phase two-dimensional, steady state, turbulent, and reacting flows, based on mass, momentum, and energy conservation laws for multiple gas species. The combustion code includes turbulence, integral combustion, and particle evaporation submodels. The newly developed integral combustion submodel makes calculations more efficient and more stable while still preserving major physical effects of the complex combustion processes. The combustor under investigation is a magnetohydrodynamic second stage combustor in which opposed jets of oxidizer are injected into a confined cross-stream of hot coal gas flow following a first stage swirl combustor. The simulation is intended to enhance the understanding of seed particle evolution in the combustor and evaluate the effects of combustor operation conditions on seed particle evolution and vapor dispersion, which directly affect overall magnetohydrodynamic power generation. Simulation results show that oxidizer jet angle and particle size have great effect on the particle evolution and vapor dispersion. At a jet angle of about 130 deg, the particle evaporation rate is the highest because of the highest average gas temperature. For particles having a smaller mean diameter, particle evaporation is more complete and vapor dispersion is more uniform. DOE

N93-22076# Los Alamos National Lab., NM.
EXPLOSIVE PULSE POWER FOR FUSION APPLICATIONS
R. E. Reinovsky, I. R. Lindemuth, S. P. Marsh, and E. A. Lopez 1992
22 p Presented at the 6th International Conference on Megagauss Magnetic Field Generation and Related Topics, Albuquerque, NM, 9-12 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003828; LA-UR-92-3759; CONF-921133-5) Avail: CASI HC A03/MF A01

Explosive pulse power systems, powered by flux compression generators and including a variety of high current power conditioning components, such as high current opening switches, are attractive for powering fusion physics experiments which require 10's MJ of electrical energy. Such systems are economical when compared to other high energy sources and require little capital investment to enable initial experiments. They are flexible and readily reconfigurable to accommodate changing experimental requirements and can be designed, assembled, and fielded in relatively short periods of time. Several configurations of very high energy flux compressors have been explored at Los Alamos and recently Russian researchers at the All Russian Institute of Experimental Physics (VNIIEF) have reported notable results from modular systems based on disk concepts. A phenomenological model of disk flux compressors is described. The performance predicted by these models is in sufficiently good agreement with the results reported by VNIIEF researchers to allow the model to be applied, in the future, to the design of power conditions systems for use in conjunction with these high performance generators. DOE

N93-22224# Argonne National Lab., IL.
SIMPLE OPTICS DESCRIPTION OF THE PLASMA SHEATH AND PLASMA ELECTRODE REGION
C. L. Fink and B. P. Curry 1992 11 p Presented at the Production and Neutralization of Negative Ions and Beams, Upton, NY, 9-13 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-004851; ANL/EP/CP-78014; CONF-921145-2) Avail: CASI HC A03/MF A01

A simple model of the optics of an ion source was developed and compared with the exact Poisson solution calculated by computer code SNOW. The model replaces the Poisson potential by a Laplacian potential that is calculated by replacing the plasma and plasma sheath by a planar plate. This Laplacian potential is then used with and without a linear space-charge correction to calculate particle trajectories. In this model the only free parameter is the distance between the planar plate and the plasma electrode. In general, there is good agreement between emittance curves calculated by the model and the SNOW results even when no space-charge correction is used. This implies for the geometry studied, that the effects of the plasma sheath and non-linear space-charge forces are small compared to aberrations introduced by the plasma aperture. DOE

N93-22406# California Univ., Los Angeles.
PISCES PROGRAM: PLASMA-MATERIALS INTERACTIONS AND EDGE-PLASMA PHYSICS RESEARCH
R. W. Conn and Y. Hirooka Jul. 1992 64 p
(Contract DE-FG03-86ER-52134)
(DE93-005089; DOE/ER-52134/T2) Avail: CASI HC A04/MF A01

This program investigates and characterizes the behavior of materials under plasma bombardment, in divertor regions. The PISCES facility is used to study divertor and plasma edge management concepts (in particular gas target divertors), as well as edge plasma turbulence and transport. The plasma source consists of a hot LaB6 cathode with an annular, water-cooled anode and attached drift tube. This cross sectional area of the plasma can be adjusted between 3 and 10 cm. A fast scanning diagnostic probe system was used for mapping plasma density profiles during biased limiter and divertor simulation experiments. Some experimental data are given on the following: (1) materials and surface physics; (2) edge plasma physics; and (3) a theoretical analysis of edge plasma modelling. DOE

N93-22419# Wisconsin Univ., Madison.
THE UNIVERSITY OF WISCONSIN-MADISON TORSATRON/STELLARATOR LABORATORY PROGRAM
Oct. 1992 16 p
(Contract DE-FG02-86ER-53216)
(DE93-005922; DOE/ER-53216/13) Avail: CASI HC A03/MF A01

A summary of results obtained during the past year of the current grant for research at the University of Wisconsin-Madison Torsatron/Stellarator Laboratory is presented along with goals for the next funding period. Research efforts have focussed on fundamental physics issues associated with toroidal confinement, predominantly through experimental investigations on the Interchangeable Module Stellarator (IMS), in the topics of fluctuations, potentials and electric fields, and plasma rotation and damping. Theoretical and computational activities have also been undertaken to support the experimental research and to identify interesting new toroidal confinement concepts which could contribute to the understanding of tokamak transport. Accomplishments during this grant period are described. DOE

N93-22427# Los Alamos National Lab., NM.
EXPERIMENTAL STUDIES OF INSTABILITIES IN RADIALLY IMPLODING PLASMAS
H. Oona, R. L. Bowers, D. L. Peterson, C. Findley, J. C. Cohrane, and J. S. Ladish 1992 15 p Presented at the 6th International Conference on Megagauss Magnetic Field Generation and Related Topics, Albuquerque, NM, 9-12 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003831; LA-UR-92-3765; CONF-921133-4) Avail: CASI HC A03/MF A01

In this paper we present experimental data from two experiments that show the initiation and growth of instabilities and compare them to a two dimensional radiational magnetohydrodynamic (RMHD) computation. High-speed cameras (Imacons) were used to observe the implosion as the plasma converges and stagnates on axis. Computer-image enhancement was used to determine the periodicity and amplitude of the initial perturbations. In the two experimental cases, the 5-cm-radius implosion foils had mass of 4.2 and 12.6 milligrams. The data show that the larger mass evolves into a more uniform implosion. Also, we determine the implosion velocity and the growth rate of a selected perturbation. DOE

N93-22428# Los Alamos National Lab., NM.
NONLINEAR INTERACTION OF MAGNETOHYDRODYNAMIC INSTABILITIES IN RADIALLY IMPLODED PLASMAS
R. L. Bowers, J. H. Brownell, A. E. Greene, H. Kruse, H. Oona, and D. L. Peterson 1992 8 p Presented at the 6th International Conference on Megagauss Magnetic Field Generation and Related Topics, Albuquerque, NM, 9-12 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003834; LA-UR-92-3774; CONF-921133-1) Avail: CASI HC A02/MF A01

The magnetic implosion of cylindrical, conducting loads has been used in pulsed power experiments for decades as a source of soft x-rays. In the Los Alamos foil implosion project we have designed and fielded experiments with thin aluminum foils which have been driven in direct drive mode, or which have employed a fast opening switch in the final pulse tailoring stage. In this paper we discuss computational modeling and the results of several experiments in which 4.24 and 12.7 mg aluminum loads were imploded in direct drive mode. In these experiments the load was at an initial radius of 5.0 cm, and the bank delivered about 3 MA to it during the implosion. One-dimensional (1-D) model of these implosions generally predict efficient conversion of magnetic energy into x-ray output and radiation pulsewidths that are very short. DOE

N93-22475*# Paris Univ. (France).
A NONEQUILIBRIUM MODEL FOR A MODERATE PRESSURE HYDROGEN MICROWAVE DISCHARGE PLASMA
Carl D. Scott Apr. 1993 34 p Sponsored by NASA. Johnson Space Center
(NASA-TM-104765; S-715; NAS 1.15:104765) Avail: CASI HC A03/MF A01

This document describes a simple nonequilibrium energy exchange and chemical reaction model to be used in a computational fluid dynamics calculation for a hydrogen plasma excited by microwaves. The model takes into account the exchange between the electrons and excited states of molecular and atomic hydrogen. Specifically, electron-translation, electron-vibration, translation-vibration, ionization, and dissociation are included. The model assumes three temperatures, translational/rotational, vibrational, and electron, each describing a Boltzmann distribution for its respective energy mode. The energy from the microwave source is coupled to the energy equation via a source term that depends on an effective electric field which must be calculated outside the present model. This electric field must be found by coupling the results of the fluid dynamics and kinetics solution with a solution to Maxwell's equations that includes the effects of the plasma permittivity. The solution to Maxwell's equations is not within the scope of this present paper. Author

N93-22513# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.
INFLUENCE OF ALPHA PARTICLE ABSORPTION ON FUNDAMENTAL DEUTERIUM HEATING IN A FUSION PLASMA
N. T. Lam, J. E. Scharer, and R. S. Sund Jan. 1993 15 p
(Contracts DE-FG02-86ER-53218; DE-FG02-93ER-54196)
(DE93-006824; UW-CPTC-93-1) Avail: CASI HC A03/MF A01

Fast wave absorption by fast alpha particles at small concentrations in ITER-like fusion plasmas is examined for the minority deuterium heating scheme. Numerical results are obtained using a full-wave code for slab geometry which solves coupled second order differential equations for the wave fields. The fast alpha particle velocity distribution is approximated by a Maxwellian chosen such that the number of resonant particles in the absorption region matches that of a slowing down distribution. For the cases considered, the fast alpha particle thermal gyroradius satisfies the condition k(perpendicular)(rho)(sub alpha(f))(exp 2) is much less than 1. Substantial absorption can occur when the Doppler-broadened alpha particle resonance extends beyond the D/T two ion hybrid resonance (on the high field side) where the left-hand circularly polarized component of the electric field peaks. DOE

N93-22522# Oak Ridge National Lab., TN.
HIGH BETA EFFECTS AND NONLINEAR EVOLUTION OF THE TAE INSTABILITY
D. A. Spong 1992 37 p Presented at the United States/Japan Workshop on Theory of High Beta Plasmas, San Diego, CA, 11-13 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004170; CONF-9211140-1-Vugraphs) Avail: CASI HC A03/MF A01

The toroidal Alfven eigenmode has recently been observed experimentally on DIII-D and TFTR when neutral beams are injected near the Alfven velocity. This instability is also of concern for future high beta D-T devices where fusion by-product alpha populations will generally be super-Alfvenic. We have developed a gyrofluid model (with Landau closure) of the TAE mode which can include most of the relevant damping mechanisms (continuum damping, ion and electron damping, ion FLR and collisional trapped electron damping) as well as reproducing analytically predicted undamped growth rates relatively accurately. An important consideration in predicting future unstable TAE regimes is the effect of finite beta in the background plasma. Due to the Shafranov shift and distortion of the flux surfaces, the location of the stable TAE root and the continuum will shift with increasing beta. The net effect of this is to generally enhance continuum damping and stabilize the TAF instability. Also, as the pressure gradient drive from the background becomes increasingly important, coupling between TAE and background driven modes can alter the TAE mode. A further application of our gyrofluid model which will be discussed is the nonlinear evolution of the TAE instability. Gyrofluid models offer a convenient reduced description which is more amenable to computational nonlinear modeling than full kinetic particle models. Our results demonstrate the rise and crash phases of TAE activity similar to experimental observations. The saturation is caused by generation of m=0 n=0 components through nonlinear beatings of the n greater than 1 modes; these cause modifications to the original equilibrium profiles in such a direction as to decrease the instability drive. This is the gyrofluid analog of direct particle losses. The peak magnetic fluctuation level increases with increasing energetic species beta, resulting in non-resonant stochastization of magnetic field lines. DOE

N93-22711# Wisconsin Univ., Madison.
PLASMAS PHYSICS RESEARCH IN THE MST TOROIDAL CONFINEMENT DEVICE
Dec. 1992 6 p
(Contract DE-FG02-85ER-53198)
(DE93-006502; DOE/ER-53198/214) Avail: CASI HC A02/MF A01

Summaries of work completed during this report period are given for the following: (1) anomalous ion heating and dynamo fluctuations; (2) current density fluctuations and ambipolarity of transport; (3) measurement of nonlinear coupling of tearing fluctuations; (4) soft x-ray observation of tearing mode phase-locking; (5) locked modes, sawteeth, and field errors in MST; and (6) boronization using a boron-carbide limiter. DOE

N93-22715# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
DEVELOPMENT OF A 100 kW CLASS PLASMA TORCH FOR ASH-MELTING PLASMA FURNACES
M. Shibuya, T. Amakawa, K. Adachi, S. Yasui, M. Iwata, T. Yamazaki (Tokyo Electric Power Co., Inc., Japan.), and K. Kinoshita (Kawasaki Steel Corp., Tokyo, Japan.) Aug. 1991 18 p In JAPANESE
(DE93-754079; CRIE-W-0384) Avail: CASI HC A03/MF A01

Wastes processing technologies are demanded in recent years for wastes increasing especially in urban areas to be turned harmless, reduced in volume, and reutilized as resources. This paper reports development of a 100 kW class plasma torch applicable to ash-melting plasma furnaces and summarizes the results of a performance verification test on the torch trially used in a 300 kW class model plasma furnace. The developed torch is of a low-flow nitrogen gas blowing type using compact and solid tungsten electrodes for the reasons of long-term durability and processing expense reduction. The trial use in the model plasma furnace proved assurance in reducing heat loss, NO(x) contained in the waste gas, and plasma gas cost, as well as the durability as a result of 100-hour continuous operation. The incineration furnace has a melting capacity of 50 kg/100kw h, which could be increased up to 100 kg with practical usefulness if an improvement is given to reduce the size. A prospect was obtained that the ash volume could be reduced by (2/3) by melting and solidifying it. The melting point temperature is about 1200 C, though depending on types of ashes. DOE

N93-22746# Los Alamos National Lab., NM.
DESIGN OF A LARGE-SCALE PLASMA SOURCE ION IMPLANTATION EXPERIMENT
B. P. Wood, J. T. Scheuer, M. A. Nastasi, R. H. Olsher, W. A. Reass, and D. J. Rej 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-7405-eng-36)
(DE93-005438; LA-UR-92-4141; CONF-921101-33) Avail: CASI HC A02/MF A01

In Plasma Source Ion Implantation (PSII), a target to be implanted is immersed in a weakly ionized plasma and pulsed to a high negative voltage. Ions in the plasma are accelerated toward the target and implanted in its surface, thereby modifying the properties of the surface. Experimental results reported in the literature have generally been for small targets. We present here the design of a large-scale PSII experiment under construction at Los Alamos National Laboratory, in which we plan to implant targets with surface areas of 1-2 sq m to doses of up to 5 x 10(exp 17) cm(exp -2). In presenting this design, we use Monte Carlo and particle-in-cell simulations to examine sheath expansion, implant current and dose, secondary electron emission, target sputtering, implant depth, and x-ray emission resulting from secondary electrons hitting the vacuum chamber wall. DOE

N93-22764# Illinois Univ., Urbana.
ANOMALOUS TRANSPORT MODELLING OF TOKAMAK PLASMAS
J. Kinsey, C. Singer, G. Malone, and N. Tiouririne 1992 23 p Presented at the Meeting of the Division of Plasma Physics of the American Physical Society, Seattle, WA, 16-20 Nov. 1992
(Contract DE-FG02-88ER-53269)
(DE93-006160; CONF-921103-7) Avail: CASI HC A03/MF A01

Theory based transport simulations of DIII-D, JET, ITER are compared to experimental data using a combination of anamolous transport models. The Multiple-mode Transport Model is calibrated to a given set of L-mode and H-mode discharges with an emphasis on testing the adequacy of anomalous flux contributions from drift/eta(sub i) and resistive ballooning mode theories. A survey of possible additions and/or alternatives to the model from recent theories on neoclassical magnetohydrodynamic (MHD) effects, hot ion modes, circulating electron modes, and high-m tearing modes is also included. DOE

N93-22769# TRW, Inc., Redondo Beach, CA. Applied Technology Div.
MHD SEED RECOVERY/REGENERATION, PHASE 2
1992 6 p
(Contract DE-AC22-87PC-79672)
(DE93-006008; DOE/PC-79672/T4) Avail: CASI HC A02/MF A01

Three tasks are reported: design, refurbish, and operate the potassium formate system; design, construct, and operate the calcium formate production POC; and Western seed studies (spent Western seed is a mixture of potassium carbonate and potassium sulfate plus inerts). DOE

N93-22779# Lawrence Livermore National Lab., CA.
APPLICATIONS OF NANOSECOND, KILOJOULE LASERS TO THE BASIC PHYSICS OF WAVES IN PLASMAS
R. P. Drake 23 Jan. 1992 13 p *Presented at the Society of* Photo-Optical Instrumentation Engineers International Symposium on Laser Spectroscopy, Los Angeles, CA, 19-24 Jan. 1992
(Contract W-7405-eng-48)
(DE93-005833; UCRL-JC-108134; CONF-920124-28) Avail: CASI HC A03/MF A01

Plasmas can sustain many normal modes of oscillation (waves), including both electromagnetic and electrostatic modes. These waves can interact by a wide variety of linear and nonlinear mechanisms, including mode coupling, mixing, and instabilities. Furthermore, such mechanisms compete so that a given wave might be absorbed, might mode convert, or might decay by one of several instabilities, depending upon the specific circumstances in which it is produced. Moreover, such waves are important in many applications, including for example laser fusion, x-ray lasers, plasma accelerators, and ionospheric heating. Laser-produced plasmas can provide an effective medium for the studies of such waves and the related mechanisms. New opportunities will be made possible by the advent of comparatively inexpensive nanosecond, kilojoule lasers. One can now contemplate affordable experiments, not limited by programmatic constraints, that could study such the basic physics of the waves in such plasmas with unprecedented precision and in unprecedented detail. DOE

N93-22796# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.
FUSION PLASMA THEORY. TASK 3: AUXILIARY RADIOFREQUENCY HEATING OF TOKAMAKS
J. E. Scharer 1992 10 p
(Contract DE-FG02-86ER-53218)
(DE93-005129; DOE/ER-53218/21) Avail: CASI HC A02/MF A01

The research performed during the past year concentrated on the following several key tokamak ICRF (Ion Cyclotron Range of Frequencies) coupling, heating, and current drive issues: (1) efficient coupling during the L- to H- mode transition by analysis and computer simulation of ICRF antennas; (2) analysis of ICRF cavity-backed coil antenna coupling to plasma edge profiles including fast and ion Bernstein wave coupling for heating and current drive; (3) benchmarking the codes to compare with current JET, D-IIID and ASDEX experimental results and predictions for advanced tokamaks such as BPX and SSAT (Steady-State Advanced Tokamak); (4) ICRF full-wave field solutions, power conservation, heating analyses, and minority ion current drive; and (5) the effects of fusion alpha particle or ion tail populations on the ICRF absorption. Research progress, publications, and conference and workshop presentations are summarized. DOE

N93-22869# Lawrence Livermore National Lab., CA.
GENERATION OF ULTRA-HIGH MAGNETIC FIELDS BY A DEGENERATE, SNOW-PLOW PINCH
C. W. Hartman, J. L. Eddleman, M. Gee, J. A. Harte, and G. B. Zimmerman 16 Dec. 1992 11 p Presented at the 6th International Conference on Megagauss Magnetic Field Generation and Related Topics, Albuquerque, NM, 9-12 Nov. 1992
(Contract W-7405-eng-48)
(DE93-005831; UCRL-JC-111529; CONF-921133-13) Avail: CASI HC A03/MF A01

We discuss 1-D and 2-D LASNEX calculations of a snow-plow pinch in Xenon. The pinch is driven by inductively stored energy, switched by a compact-torus, fast-opening switch, with performance characteristics calculated by the TRACII, 2-D, MHD code. The 10-cm initial radius, 1 cm long Xe pinch, is driven by 50 MA current thatis switched on in 100 ns. The pinch uniquely undergoes radiative collapse during the snow-plow phase, conforming to the original description of the 'snow-plow', to form a high-density, high-kinetic energy Xe shell which dynamically converges to a pinch equilibrium with degenerate electron pressure, high-density high-magnetic field. The described pinch configuration, calculated in 1-D, is expected to be unstable to R-T, sausage, and kink instabilities. A small initial B(sub zo) field (approximately 100 G) is calculated to be compressed to B(sub z) approximately = B (sub theta) at the final, degenerate, pinch equilibrium, thus stabilizing sausage instability. A larger initial B(sub z) field (approximately 10 kG) is calculated to be compressed by the radiatively collapsing plasma in the snow-plow to B(sub z) approximately = B (sub theta) to stabilize R-T instability during the snow-plow phase. Finally, the kink instability (if it occurs) is expected, as observed, to leave intact the tightly pinched plasma column. DOE

N93-22907# Los Alamos National Lab., NM.
RADIATION MAGNETOHYDRODYNAMIC MODELING OF X RAY OUTPUT FROM PERTURBED PLASMA IMPLOSIONS
D. L. Peterson, R. L. Bowers, J. H. Brownell, A. E. Greene, H. W. Kruse, H. Lee, and W. Matuska 1992 9 p Presented at the 6th International Conference on Megagauss Magnetic Field Generation and Related Topics, Albuquerque, NM, 9-12 Nov. 1992
(Contract W-7405-eng-36)
(DE93-005454; LA-UR-92-3992; CONF-921133-11) Avail: CASI HC A02/MF A01

A goal of the Los Alamos foil implosion project, TRAILMASTER, is the development of a laboratory source of soft x-rays from the magnetically driven implosion of a plasma shell from a thin cylindrical foil. One problem which arises in such implosions is the potential degradation of radiation output due to magnetohydrodynamic instabilities which may exist in the imploding plasma. The result of the instability growth is a thickened plasma shell and the arrival of material and magnetic field on-axis ahead of the plasma shell. This in turn broadens the radiation pulse and lowers the peak temperature which can be obtained from the implosion. Experiments have been performed on the Pegasus 1.5 MJ capacitor bank facility to examine the development of MHD instability growth, the subsequent effect on the radiation pulse, and to provide information which can be used to benchmark our 1-D and 2-D simulations of such implosions. DOE

N93-22940# Oak Ridge National Lab., TN.
ALPHA EFFECTS ON TAE MODES AND ALPHA TRANSPORT
C. Z. Cheng, G. Y. Fu, H. E. Mynick, R. Budny, R. B. White, S. J. Zweben (Princeton Univ., NJ.), C. T. Hsu, and D. J. Sigmar 1992 22 p Presented at the 14th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Wuerzburg, Germany, 30 Sep. - 7 Oct. 1992
(Contracts DE-AC05-84OR-21400; DE-AC02-76CH-03073; DE-AC02-78ET-51013)
(DE93-004160; CONF-920913-24; IAEA-CN-56/D-2-1(C)) Avail: CASI HC A03/MF A01

In a fusion reactor, any unanticipated loss of alpha power could result in serious wall damage, impurity influx, major operational control problems, and even a failure to sustain ignition. Neutral beam injection (NBI) experiments in large tokamaks have indicated that toroidicity-induced Alfven eigenmode (TAE) can be strongly unstable and cause the loss of about half of the fast beam ions. This level of loss would be unacceptable in fusion reactors. Recent experiments in TFTR indicate that TAE modes can also be excited by energetic particles heated by ICRF. Stability of TAE modes in the presence of alpha particles had previously been studied by employing a global kinetic-MHD stability code (NOVA-K). The alpha transport due to a single toroidal mode number TAE mode had also been studied by using a Hamiltonian guiding center orbit code, ORBIT. In section 1, we present the properties of the TAE mode, the effects of alpha particles on TAE instabilities for TFTR D-T and ITER experiments. The alpha transport due to multiple toroidal mode number TAE modes and a stochastic transport theory are presented. DOE

N93-22942# Oak Ridge National Lab., TN.
DISSIPATIVE TRAPPED ELECTRON MODE TURBULENCE WITH ION LANDAU DAMPING AND FLR EFFECTS
N. Dominguez 1992 19 p Presented at the Meeting of the Division of Plasma Physics of the American Physical Society, Seattle, WA, 16-20 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004524; CONF-921103-4-Vugraphs) Avail: CASI HC A03/MF A01

The following topics are discussed: relation to larger effort; slab geometry; linear dissipative trapped electron modes (DTEM); motivation; local analysis; radially resolved calculations; ion dynamics; electron dynamics and dispersion relation; linear model for DTEM; nonlinear model for DTEM; and nonlinear results. DOE

N93-22984# New York Univ., New York. Inst. of Mathematical Sciences.
A HIGH PERFORMANCE SPECTRAL CODE FOR NONLINEAR MHD STABILITY
M. Taylor Sep. 1992 75 p
(Contract DE-FG02-86ER-53223)
(DE93-004541; DOE/ER-53223/193) Avail: CASI HC A04/MF A01

A new spectral code, NSTAB, was developed to do nonlinear stability and equilibrium calculations for the magnetohydrodynamic (MHD) equations in three dimensional toroidal geometries. The code has the resolution to test nonlinear stability by calculating bifurcated equilibria directly. These equilibria consist of weak solutions with current sheets near rational surfaces and other less localized modes. Bifurcated equilibria with a pronounced current sheet where the rotational transform crosses unity are calculated for the International Thermonuclear Experimental Reactor (ITER). Bifurcated solutions with broader resonances are found for the LHD stellarator currently being built in Japan and an optimized configuration like the Wendelstein V2-X proposed for construction in Germany. The code is able to handle the many harmonics required to capture the high mode number of these instabilities. NSTAB builds on the highly successful BETAS code, which applies the spectral method to a flux coordinate formulation of the variational principle associated with the MHD equilibrium equations. However, a new residue condition for the location of the magnetic axis was developed and implemented. This condition is based on the weak formulation of the equations and imposes no constraints on the inner flux surfaces. DOE

N93-23023# General Atomic Co., San Diego, CA.
APPLICATIONS OF DIVERTOR BIASING TO THE NEXT GENERATION TOKAMAKS
M. A. Mahdavi, T. E. Evans, A. W. Hyatt, A. W. Leonard, S. I. Lippmann, T. W. Petrie, M. J. Schaffer, D. L. Sevier, J. P. Smith, and G. M. Staebler et al Sep. 1992 16 p Presented at the International Atomic Energy Agency Technical Committee Meeting on Takamak Plasma Biasing, Montreal, Ottawa, 8-10 Sep. 1992
(Contracts DE-AC03-89ER-51114; W-7405-eng-48)
(DE93-005848; GA-A-21060; CONF-9209181-6) Avail: CASI HC A03/MF A01

Divertor biasing is a new technique with a growing number of applications to both plasma physics understanding and performance enhancement. In this paper we discuss the potentials of several biasing concepts for their applications to the next generation tokamaks. DOE

N93-23066 Auburn Univ., AL.
ELECTRON CYCLOTRON EMISSION MEASUREMENTS ON THE TEXAS EXPERIMENTAL TOKAMAK Ph.D. Thesis
Max Eugene Austin, Jr. 1992 133 p
Avail: Univ. Microfilms Order No. DA9237176

A ten-channel grating polychromator was designed, constructed, and installed on the Texas Experimental Tokamak to monitor the second harmonic electron cyclotron emission. Electron temperature profiles were derived from measurements of the optically thick radiation for a variety of plasma confinement experiments. The radial and temporal evolution of T(sub e) has been characterized for electron cyclotron heated discharges with 150 kW of 60 GHz power. Comparisons were made of the heating efficiency of two type of ECH launchers. A focussed launcher was shown to have slightly better heating efficiency than an unfocussed launcher; however, the focussed antenna did not yield significantly higher electron

temperatures as expected. A study of the time evolution of the electron temperature indicated that increased sawtooth activity limited the effectiveness of the focussed launcher. A focussing hog-horn antenna was fabricated and installed on the inboard side of the tokamak to measure emission directed towards the high-field side during ECH. Comparison of the radiation temperature profiles from low-field side and high-field side antennas indicates the creation of a nonthermal electron distribution by the heating. The results of the experiment compare favorably with theoretical predictions from a quasi-linear Fokker-Planck code of a 6 keV nonthermal population with a density about 1 percent of the thermal density.
Dissert. Abstr.

N93-23167 Rensselaer Polytechnic Inst., Troy, NY.
SELECTION OF AN APPROPRIATE TOKAMAK OPERATING REGIME USING MAGNETOHYDRODYNAMIC AND CURRENT DRIVE CONSTRAINTS Ph.D. Thesis
Marc Louis Klasky 1992 333 p
Avail: Univ. Microfilms Order No. DA9236230

Ideal and resistive MHD stability theories are employed to examine tokamak operating regimes. A constraint on the level of non-inductive current drive, consistent with the previous stability theories, is also considered. These three operational requirements are examined with the ideal energy principle of Bernstein, the resistive principle of Chu, and RF current drive analysis. In this thesis we have found that operation at high aspect ratio (greater than 4) in conjunction with both high axis safety factor (approximately 2) and edge safety factor (approximately 8) satisfies the constraints of being free from both ideal and resistive tearing modes while simultaneously operating at an acceptable level of driven toroidal current due to appearance of the bootstrap current. It has also been found that in order to extend the resistive energy principle of Chu to systems with finite plasma pressure it was necessary to develop a method to treat the singularities that arise in these systems. The Generalized Green's Function method provides such a method to eliminate the numerical singularities. Thus, the formulism to treat the resistive tearing mode stability of finite pressure tokamaks has not been established. Dissert. Abstr.

N93-23242 Houston Univ., TX.
MULTIPLY CHARGED IONS FROM LASER DRIVEN PLASMA SOURCES Ph.D. Thesis
Myonggwon Park 1992 176 p
Avail: Univ. Microfilms Order No. DA9236158

The temporal and spatial characteristics of plasma ion current produced from the laser irradiation (10(exp 9) - 10(exp 11) W/sq cm at 1.06 microns) on solid targets have been studied experimentally and compared to a simple theoretical model. The data collection and acquisition system includes a Faraday cup coupled with preamplifier circuit, a high speed waveform digitizer, and a computer system interfaced via CAMAC and a GPIB bus. The data obtained with this system proved to be highly reproducible, resulting in reliable and quantitative data analysis. A self-similar hydrodynamic expansion model has been adopted to analyze the laser plasma expansion into the vacuum. The plasma density, expansion velocity, temperature, and pressure in conjunction with the laser beam absorption and dissipation processes are considered as the governing parameters to describe the asymptotic behavior of the laser excited plasma. The numerical calculations demonstrate that the model well represents experimental observations. The results indicate that a substantial fraction of the input laser energy is transported to energetic ions expanding into the vacuum. The fast ions have keV kinetic energies and these energies tend to increase as the irradiation power density increases. At a laser intensity of approximately 10(exp 11) W/sq cm, the ion current distribution begins to show strong directionality along a line normal to the target plane, while at an input beam intensity below 3 x 10(exp 9) W/sq cm, the plasma ion currents show more spherically uniform distributions. Dissert. Abstr.

N93-23258# Stuttgart Univ. (Germany). Inst. fuer Plasmaforschung.
[ACTIVITIES REPORT OF THE INSTITUTE OF PLASMA RESEARCH] Annual Report, 1991
K. Behringer 1992 33 p
(ETN-93-93527) Avail: CASI HC A03/MF A01

Theoretical and experimental investigations on the following are reported: Electron Cyclotron Resonance Heating (ECRH) (the operation of 140 GHz ECRH); laser diagnostics (FIR collective scattering on ASDEX, FIR frequency shifting, and numerical calculation of corrugated mirrors); plasma edge diagnostics (chemical impurity production and atomic rate coefficients); plasma theory (electromagnetic wave propagation, the boundary sheath in a plasma reactor, HF behavior of electrostatic boundary sheaths in LF discharges, and Langmuir solitons); plasma technology (deposition of thin films and surface treatment of polymers, ECR device for preparation of diamond like films, and the RF parallel plate reactor); plasma focus (the Poseidon plama focus experiment and DPF-78 experiments). Lists of publications, theses, and laboratory reports are given. For individual titles, see N93-23259 through N93-23264.

N93-23259# Stuttgart Univ. (Germany).
ELECTRON CYCLOTRON RESONANCE HEATING (ECRH)
R. Wienecke, V. Erckmann (Institut fuer Plasmaphysik G.m.b.H., Garching, Germany.), W. Kasparek, H. Kumric, G. A. Mueller, J. Pretterebner, P. G. Schueller, and D. Wagner *In its* Activities Report of the Institute of Plasma Research 1992 p 1-12 (For primary document see N93-23258 08-75)
Avail: CASI HC A03/MF A01

A pilot experiment with 140 GHz Electron Cyclotron Resonance Heating (ECRH) was prepared in 1990 and successfully operated in 1991. The gyrotron microwave source and the quasi optical transmission line for the 140 GHz radiation show the expected technical performance to guarantee a reliable experimental condition. Technical innovations and quality tests of the quasi optical transmission line are discussed. The successful operation of 140 GHz ECRH in the first half of 1991 encouraged the planning of stepwise replacement of the 70 GHz/200 kW units by 140 GHz/400 kW units. An application for preferential support of EURATOM phases 1 and 2 was approved at the end of 1991. ESA

N93-23260# Stuttgart Univ. (Germany).
LASER DIAGNOSTICS **c36**
G. Dodel, E. Holzhauer, G. Rohrbach, A. Allmendinger, and K. Kopp *In its* Activities Report of the Institute of Plasma Research 1992 p 12-15 (For primary document see N93-23258 08-75)
Avail: CASI HC A01/MF A01

The main emphasis in the evaluation of FIR scattering data was on the evolution of fluctuation spectra at the L-H transition with high temporal resolution and a comparison with other diagnostics recorded simultaneously in a fast multichannel data acquisition system. For FIR frequency shifting, the possibility of using a rotating grating in a multi-diffraction set up where the FIR beam is Doppler shifted several times at the same grating was investigated. Elliptical mirrors were designed to compensate for the distortion of the beam profile. Results for a set-up using 8 diffractions are given. For the numerical calculation of corrugated mirrors, Maxwell's equations were solved by using finite difference equations to obtain the near and far field distributions. The case of perpendicular incidence on corrugated surfaces was treated to obtain the phase shift between the transverse electric (TE) and transverse magnetic (TM) modes in polarization twisters and mode converters. An important aspect for high power applications is the maximum electric field strength in the metallic surface because of the danger of electrical breakdown. Therefore the spatial distribution of the modulus of the electric field was calculated for different groove contours. As an example, the phase shift for polarization twisters is shown for rectangular grooves.
ESA

N93-23261# Stuttgart Univ. (Germany).
PLASMA EDGE DIAGNOSTICS
K. Behringer, A. Dodhy, U. Fantz, T. Schuette, and K. Schwoerer *In its* Activities Report of the Institute of Plasma Research 1992 p 15-19 (For primary document see N93-23258 08-75)
Avail: CASI HC A01/MF A01

Chemical reactions that involve hydrogen, deuterium, or oxygen reacting with graphite target and protection plates can lead to chemical erosion of these surfaces. These reactions are seen as important problems in the development of fusion reactors. Computer simulation of the CH/CD A-X molecular bands is discussed as part of the analysis. The results of personal computer programs set up for calculating the respective term values, the term differences, and the wavelengths in air are shown. Investigations of CH(+)/CD(+) molecular bands and molecular spectra of H2 and D2 are reported. For atomic rate coefficients, results on the following are discussed:

electron excitation of atomic hydrogen; the results of excitation rates for other ions; ADAS population calculations; and processed data for code calculations. ESA

N93-23262# Stuttgart Univ. (Germany).
PLASMA THEORY
E. Raeuchle, K. Banzhaf, R. Deutsch, F. Moser, A. Theurer, and C. Zhou *In its* Activities Report of the Institute of Plasma Research 1992 p 19-21 (For primary document see N93-23258 08-75)
Avail: CASI HC A01/MF A01

Investigation of the propagation of electromagnetic waves in inhomogenous plasmas within the approximation of geometrical optics is reported. The theoretical investigation of the collisionless boundary sheath of a plasma containing negative ions in plasma reactors is described. Investigation of the HF behavior of electrostatic plasma boundary sheath in LF discharges is illustrated. The numerical investigation of Langmuir solitons is reported, and two penetrating solitons are shown. ESA

N93-23263# Stuttgart Univ. (Germany).
PLASMA TECHNOLOGY
R. Wienecke, E. Raeuchle, K. M. Baumgaertner, T. Magg, W. Petasch, H. Petto, M. Shahkatre, M. Stoschek, and M. Walker *In its* Activities Report of the Institute of Plasma Physics 1992 p 21-23 (For primary document see N93-23258 08-75)
Avail: CASI HC A01/MF A01

The use of microwaves to produce low pressure plasmas for plasma technological applications, such as the surface treatment of materials and the deposition of thin films, is reported. The deposition of thin polymeric quartz like films in a plasma produced by microwaves with an electron cyclotron resonance (ECR) zone and investigation of infrared spectra of the polymeric sheets by the ATR method are described. The use of an ECR device for preparation of diamond like films is described. An investigation of a RF parallel plate reactor, including modeling of the external electrical components and the plasma, is reported. ESA

N93-23264# Stuttgart Univ. (Germany).
PLASMA FOCUS
H. Herold, R. Aliaga, C. Dumitrescu-Zoita, D. Franz, H. J. Kaeppeler, H. Schmidt, and D. Schulz *In its* Activities Report of the Institute of Plasma Research 1992 p 24-26 (For primary document see N93-23258 08-75)
Avail: CASI HC A01/MF A01

Fast valve for gas puffing in the Poseidon plasma focus experiment is reported. An electromagnetic gas value was built, tested, and applied for first experiments. Linear compression using 'bubbles' is concluded to be a difficult approach for the production of very high density plasmas. DPF-78 experiments are reported. In particular, the following are described: micropinch formation; x-ray spectroscopic measurements; micropinch dynamics; and micropinch emission. ESA

N93-23497 Essex Univ., Colchester (England).
X RAY ABSORPTION SPECTROSCOPY OF DENSE, SHOCK COMPRESSED, LASER PLASMA Ph.D. Thesis
D. A. Goodman 1992 228 p
Avail: Univ. Microfilms Order No. BRD-97222

The central theme of this work involves the diagnosis of shock compressed highly correlated laser plasmas, by observation of the Extended X-ray Absorption Fine Structure (EXAFS) in the absorption spectrum. Measurements have been made using a plane crystal mini-spectrometer and a spectrometer purpose built for EXAFS measurement which employed an elliptically curved x-ray dispersing crystal. Chapter 1 serves as a very brief introduction to the plasma state, and describes how the strongly coupled plasmas which are of interest to this work are created, through laser interaction, and theoretically modelled. Chapters 2, 3 and 4 concern the development and the testing of the elliptical spectrometer. Chapter 2 introduces the theoretical models and concepts which have been developed to predict the behavior of the spectrometer, and demonstrate how these predictions have influenced the spectrometer design. Chapter 3 charts the development of the EXAFS spectrometer from the early plane crystal geometry to the successful elliptical crystal arrangement. Also described is the process by which the x-ray dispersing crystals are bent to the correct elliptical contour. Chapter 4 describes the testing of the elliptical spectrometer prior to EXAFS measurement, in order to assess the viability of the spectrometer alignment procedure and the general viability of the spectrometer as a diagnostic device. Chapter 5 is concerned with the experimental details of the plasma EXAFS studies. The use of both planar and elliptical crystal spectrometers, in the VULCAN glass laser environment is described. Chapter 6 is concerned with the analysis of the experimental results. The models by which the density, temperature and ion correlation are calculated are introduced, and applied to EXAFS measurements from both spectrometers. The results are presented in tabular and graphical form and discussed at length. Chapter 7 assesses the feasibility of replacing x-ray film with a commercially available solid state detector in order to measure the x-ray emission from laser produced plasma. The two types of detector and their relative merits are described, and the results of an experiment designed to compare and contrast their performance is presented. Chapter 8 is a summary of the work presented in this thesis, and suggests some possible avenues for future research. Dissert. Abstr.

N93-23676# Lawrence Livermore National Lab., CA.
EXPERIMENTAL DETERMINATION OF THE HYDRODYNAMIC INSTABILITY GROWTH RATES IN INDIRECT AND DIRECT DRIVE ICF
J. D. Kilkenny, D. H. Munro, S. W. Haan, S. G. Glendining, B. A. Remington, S. V. Weber, R. J. Wallace, H. T. Powell, S. Dixit, and J. P. Knauer et al 1 Sep. 1992 18 p Presented at the 14th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Wurzburg (Germany), 30 Sep. - 7 Oct. 1992
(Contract W-7405-eng-48)
(DE93-006278; UCRL-JC-110277; CONF-9209290-5; IAEA-CN-56/B-3-2)
Avail: CASI HC A03/MF A01

A comprehensive set of measurements of the growth of ablatively stabilized Rayleigh Taylor instabilities in laser driven direct drive and indirectly drive planar foils is presented. For both cases, imposed single Fourier modes are seen to grow as a planar foil is accelerated. Harmonics of the imposed wavelength are observed as the sinusoidal perturbation becomes a classic bubble and spike. Independent measurements of the foil acceleration are made by sidelighting the foils. For small amplitude initial perturbations, a shaped indirect drive has been used to achieve growth rates as large as 80. Two dimensional simulations of the foils demonstrate excellent agreement with the measured growth rates and non-linear saturation. For both direct and indirect drive, the small amplitude growth rates are seen to be in agreement with simple dispersion relations gamma = alpha (radical)kg - beta kv(sub a) albeit with different values of the constants for the two cases. Further experiments with radiatively accelerated planar foils with two imposed modes of wavenumber k1 and k2 show mode coupling with sum and difference modes, again in agreement with theory. Experiments have also been performed measuring the modulations in areal density of unperturbed foils. The early time non-uniformity of the laser beam can be varied by changing the bandwidth of the SSD smoothing scheme. As the smoothing of the laser drive beam is increased, the degree of non-uniformity of the accelerated foil decreases. For indirect drive there is no measurable non-uniformity of an initially smooth accelerated foil. Indirect drive experiments need a rough foil with a 4 micron surface finish to see any growth of Rayleigh Taylor non-uniformity. DOE

N93-23690# General Atomic Co., San Diego, CA.
RECENT D3-D RESULTS
T. C. Simonen Oct. 1992 16 p Presented at the 14th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Wuerzburg, Germany, 30 Sep. - 7 Oct. 1992
(Contracts DE-AC03-89ER-51114; W-7405-eng-48; DE-FG03-89ER-51121; DE-AC05-84OR-21400)
(DE93-004468; GA-A-21089; CONF-920913-25) Avail: CASI HC A03/MF A01

Recent experimental results from the DIII-D tokamak point in directions that could lead to a commercially attractive tokamak demonstration reactor concept, with enhanced confinement, stability, current drive, and divertor performance. These recent results include electric-field and plasma current profile control, noninductive current drive, and divertor power and particle control. Edge radial electric field shear suppresses edge turbulence and improves confinement in H-mode discharges. The electric field extends deeper into VH-mode plasmas and may explain the improved confinement. In VH-mode plasmas the fusion triple product has increased to n(sub D)(0) tau(sub E) T(sub i)(0) = 2 x 10(exp 20) m(sup -3) s keV and the central

electron temperature to 7 keV. Experiments with current profile control have shown improved confinement and stability, access to second stability, and the suppression of TAE modes. Low power fast wave current drive experiments at the 1 MW power level have driven currents at the 0.1 MA level. Divertor experiments indicate that the modeling codes overestimate peak divertor power fluxes. With deuterium gas injection into the divertor, the peak diverter power flux has been reduced by a factor of 5. Edge localized modes (ELMs) are shown to purge helium from the core plasma to the divertor chamber where, in a reactor, the alpha ash could be pumped away. DOE

N93-23987# Northeastern Univ., Boston, MA.
ON THE DYNAMICS OF SPACE PLASMA Final Report, 6 Mar. 1989 - 1 Sep. 1992
Jay Albert, Chung Chan, Michael Silevitch, and Elena Villalon 1 Sep. 1992 226 p
(Contract F19628-89-K-0014)
(AD-A259898; PL-TR-92-2217) Avail: CASI HC A11/MF A03

The research was focused into three related areas. These were: (1) an examination of stochastic electron acceleration mechanisms in the ionosphere and the resulting dynamics of magnetospheric (i.e., Radiation Belt) particles and waves; (2) a study of nonadiabatic particle orbits and the electrodynamic structure of the coupled magnetosphere-ionosphere auroral arc system; (3) an experimental investigation of the wake signatures created by a solid body immersed in a flowing plasma. GRA

N93-23998 California Univ., Irvine.
EQUILIBRIA AND STABILITY OF NON-ADIABATIC VLASOV-MAXWELLIAN PLASMAS Ph.D. Thesis
Brett Alverson Spivey 1992 90 p
Avail: Univ. Microfilms Order No. DA9233698

Adiabatic plasma physics, whereby particles gyrate tightly around magnetic field lines, constitutes a well studied area of plasma physics. On the other hand, plasmas in which a significant number of particles have orbits comparable to the confinement scale have many interesting properties which are not yet well understood. In particular, high energy particles appear to ignore turbulence, and do not behave like fluids. MHD equations cannot generally be adapted to modeling of non-adiabatic plasma; for example, the field reversed configuration is predicted in the MHD model to have a tilt mode instability which is not experimentally observed. We consider in this dissertation the general case of arbitrary orbit size. Specifically, the solutions which we consider are drifted Maxwellian distributions which satisfy the Vlasov equation, and we call these Vlasov-Maxwellian (or V-M) solutions. The Maxwellian form for the distribution function is chosen for its immunity to ion-ion collisional diffusion, which becomes more significant as Larmor radius is increased. We impose the condition that all Maxwellian ion species have common temperature and drift velocity so that the ion-ion collision operator collapses to zero. In section 2 we derive self-consistent equilibria for V-M plasmas. First we show that all V-M plasmas must be rigid rotors. Next we derive the V-M equilibrium equation for a single ion species. Finally we numerically evaluate several solutions in finite geometry. Solutions are found which are field reversed and have high density contrast. In section 3 an electrostatic linear stability analysis is carried out for a restricted class of V-M plasmas. The cases considered involve cylindrical geometry and are finite in the radial direction. A dispersion relation is obtained which is sufficiently simple that a complete investigation of finite orbit stability can be carried out. Both analytic and numerical stability analyses are presented. Dissert. Abstr.

N93-24035# Tennessee Univ. Space Inst., Tullahoma.
THREE-DIMENSIONAL ISOTHERMAL FLOW SIMULATIONS OF AN MHD SECONDARY COMBUSTOR
J. J. Lee 1993 9 p Presented at the 31st American Institute of Astronautics and Aeronautics Aerospace Sciences Meeting, Reno, NV, 11-14 Jan. 1993
(Contract DE-AC02-79ET-10815)
(DE93-006631; DOE/ET-10815/204; CONF-930108-4; AIAA Paper 93-0816) Avail: CASI HC A02/MF A01

This paper describes numerical prediction of the three-dimensional turbulent nonreacting flow inside an MHD secondary combustor. The Navier-Stokes equations have been solved, using the LEE-3 computer code. The effect of varying jet-to-crossflow velocity ratio and jet angle upon the interaction of the jets and the mainstream has been predicted. The calculated velocity vectors are compared with experimental data based on the same inlet Reynolds numbers. It is observed that the general features of the flow are well predicted, but there are appreciable discrepancies between measured and calculated values. The major disagreements may be due to result from the inlet boundary conditions. DOE

N93-24042# Mississippi State Univ., Mississippi State. Diagnostic Instrumentation and Analysis Lab.
OPTICAL DIAGNOSTICS IN SUPERSONIC PLASMA FLOWS: PURGING FLUID EFFECTS
C. W. Bouchillon, O. P. Norton, and R. L. Cook 1993 10 p Presented at the 31st American Institute of Astronautics and Aeronautics Aerospace Sciences Meeting, Reno, NV, 11-14 Jan. 1993
(Contract DE-AC02-80ET-15601)
(DE93-006243; AIAA Paper 93-0821; CONF-930108-3) Avail: CASI HC A02/MF A01

Magnetohydrodynamic topping cycles are being planned for electrical power production in conjunction with conventional fossil fueled power plants. In order to develop proper designs and to provide for better control and safety, it is desirable to make measurements in the plasma flows which are used in the MHD process. Noninvasive optically based instruments are well suited to this purpose. In order to use these optically based instruments, optically transparent viewports are required to allow observations of the plasma flow conditions. A purge/impulse fluid flow system has been devised to provide continuous optical access to the flow by DIAL. The presence of the purge flows in the supersonic section of the MHD system may have an effect on the flow characteristics and consequently, the effectiveness of the electrical energy generation or on the long-term reliability of the power train. A numerical evaluation of the resulting flow field in a supersonic duct with purge flow viewports has been made and results are presented which illustrate the predicted effects of the purge flow under steady state conditions. The only significant effect on the plasma flow was in the temperature distribution near the wall downstream and in the plane of the viewpoints. DOE

N93-24045# Georgia Inst. of Tech., Atlanta.
A TRANSMISSION/ESCAPE PROBABILITIES MODEL FOR NEUTRAL PARTICLE TRANSPORT IN THE OUTER REGIONS OF A DIVERTED TOKAMAK
W. M. Stacey Dec. 1992 34 p
(Contract DE-FG05-91ER-54122)
(DE93-006550; GTFR-105) Avail: CASI HC A03/MF A01

A new computational model for neutral particle transport in the outer regions of a diverted tokamak plasma chamber is presented. The model is based on the calculation of transmission and escape probabilities using first-flight integral transport theory and the balancing of fluxes across the surfaces bounding the various regions. The geometrical complexity of the problem is included in precomputed probabilities which depend only on the mean free path of the region. DOE

N93-24052# Naval Research Lab., Washington, DC.
NONLINEAR ANALYSIS OF RELATIVISTIC HARMONIC GENERATION BY INTENSE LASERS IN PLASMAS Interim Report
Eric Esarey, Antonio Ting, Phillip Sprangle, Donald Umstadtert, and X. Liut 8 Jan. 1993 32 p
(AD-A260092; NRL/MR/6790-93-7158) Avail: CASI HC A03/MF A01

A linearly polarized, ultra-intense laser field induces transverse plasma currents which are highly relativistic and nonlinear, resulting in the generation of coherent harmonic radiation in the forward direction (i.e., co-propagating with the incident laser field). A nonlinear cold fluid model, valid for ultrahigh intensities, is formulated and used to analyze relativistic harmonic generation. The plasma density response is included self-consistency and is shown to significantly reduce the current driving the harmonic radiation. Phase detuning severely limits the growth of the harmonic radiation. The effects of diffraction are considered in the mildly relativistic limit. No third harmonic signal will emerge from a uniform plasma of near infinite extent. A finite third harmonic signal requires the use of a semi-infinite or finite slab plasma. For an initially uniform plasma, no second harmonic radiation is generated. Generation of even harmonics requires transverse gradients in the initial plasma density profile. GRA

N93-24107 Oxford Univ. (England).
SPACE CHARGE LAYERS IN A DOUBLE PLASMA MACHINE Ph.D. Thesis
G. Hassall 1991 240 p
Avail: Univ. Microfilms Order No. BRD-97312

The formation of space charge layers in a gas discharge system is responsible for many varied phenomena with perhaps the most common example being the wall-sheath. Increasing the number of layers can further complicate the self-consistent potential structure of this region which may, in turn, modify the behavior of the overall system. This thesis describes both experimental and numerical studies in which structures such as these were investigated. In the experimental phase of this work, a Triple Plasma Machine (TPM) was used in a Double Plasma Machine (DPM) configuration. Extensive preliminary evaluation experiments were conducted in which the characteristics of both the multidipole plasma source and the experimental chamber were studied. From this it was possible to estimate the form of the particle distribution injected into the target chamber which produces these space charge structures adjacent to the emitting surface represented by the plasma source in much the same way that a sheath forms adjacent to hot electron emitting cathode in a conventional discharge tube experiment. Studies of their evolution as functions of various machine parameters produced distinct correlations between their detailed potential structure and properties such as the device current-voltage characteristics. As an aid to interpreting some of the experimental results a simple one-dimensional steady state Vlasov-Poisson model was constructed which helped evaluate the influence of each of the electron and ion populations suggested by results of the experimental work. Although of limited use because of its time independence it could show that anomalies observed in the sheath structures noted in this work and elsewhere could be reproduced using a realistic combination of the particle populations indicated in the experimental stages of this thesis. Dissert. Abstr.

N93-24187 Maryland Univ., College Park.
ANALYSIS OF NON-THERMAL ELECTRON CYCLOTRON EMISSION DURING ELECTRON CYCLOTRON CURRENT DRIVE EXPERIMENTS ON THE D3-D TOKAMAK Ph.D. Thesis
Scott J. Janz 1992 165 p
Avail: Univ. Microfilms Order No. DA9234586

Non-thermal electron distributions are diagnosed employing a fast scanning Michelson Interferometer which is capable of viewing the plasma vertically (constant B(sub toroidal)) along a chord at r/a approx. = .6 terminated by a highly absorptive Macor viewing dump, and horizontally at the midplane. Extraordinary (X) mode and Ordinary (O) mode polarizations of Electron Cyclotron Emission (ECE) in the second to the tenth harmonic of the fundamental electron cyclotron frequency have been collected under a variety of plasma conditions, during high power microwave injection at 60 GHz in the DIII-D Tokamak. Plasma refraction limits the data analysis to frequencies above the fifth harmonic where the data is characterized by a smooth, exponentially decreasing intensity, due to the high degree of harmonic overlap in this frequency range. Analysis of this data has shown the extreme sensitivity of this diagnostic to emission from high pitch angle particles. Results of delta function distribution calculations and distribution function fitting show that for a low density target plasma (central line averaged n(sub e) = 0.5 x 10(exp 13) cm(exp -3)), the emission is dominated by electrons near the trapping boundary at our viewing location, with average energies 400 keV less than (E) less than 500 keV during ECH. Under higher plasma target density conditions (central line averaged n(sub e) = 1.0 x 10(exp 13) cm(exp -3)) the population of electrons during ECH contributing to the emission increases in average energy to (E) approx. = 1.2 MeV as a result of the residual electric field induced by the primary transformer. Non-thermal electron densities (n(sub hot)) of approx. 1 x 10(exp 10) cm(exp -3) are estimated during the ECH phase while the post-ECH phase is characterized by a very diffuse (n(sub hot) approx. 5 x 10(exp 7) cm(exp -3)), energetic ((E) approx. 1.5 MeV), population in the trapped region of momentum space. Dissert. Abstr.

N93-24294 California Univ., Davis.
POLOIDAL MAGNETIC FIELD PROFILE MEASUREMENTS ON THE MICROWAVE TOKAMAK EXPERIMENT USING FAR-INFRARED POLARIMETRY Ph.D. Thesis
Bradley Woodward Rice 1992 251 p
Avail. Univ. Microfilms Order No. DA9302621

The measurement of plasma poloidal magnetic field (B(theta)) profiles on tokamaks with good temporal and spatial resolution has proven to be a difficult but important measurement. A large range of toroidal confinement phenomena is expected to depend sensitively on the radial variation of B(theta) (or equivalently the current density J or safety factor q) including the tearing instability, sawtooth oscillations, disruptions, and transport. Experimental confirmation of theoretical models describing these phenomena has been hampered by the lack of detailed B(theta) measurements. A fifteen chord far-infrared (FIR) polarimeter has been developed to measure B(theta) in the Microwave Tokamak Experiment (MTX). Polarimetry utilizes the well-known Faraday rotation effect, which causes a rotation of the polarization of an FIR beam propagating in the poloidal plane. The rotation angle is proportional to the component of B(theta) parallel to the beam. A new technique for determining the Faraday rotation angle is introduced, based on phase measurements of a rotating polarization ellipse. This technique simplifies the implementation of large multi-chord systems, and minimizes the effect of amplitude variations caused by refraction. This instrument has been used successfully to measure B(theta) profiles for a wide range of experiments on MTX. For ohmic discharges, measurements of the safety factor on axis give q(0) approximately 0.75 during sawteeth and q(0) greater than 1 without sawteeth. Large perturbations to the polarimeter signals correlated with the sawtooth crash are observed during some discharges. Measurements in discharges with electron cyclotron heating (ECH) show a transition from a hollow to peaked J profile that is triggered by the ECH pulse. Heavy-metal impurity radiation is believed to be the cause of the initially hollow profile. Current-ramp experiments were done to perturb the J profile from the nominal Spitzer conductivity profile. Profiles for initial current ramps and ramps starting from a stable equilibrium have been measured and are compared with cylindrical diffusion model. Finally, the tearing model stability equation is solved using measured J profiles. Stability predictions are in good agreement with the existence of oscillations observed on the magnetic loops. Dissert. Abstr.

N93-24325# General Atomics Technologies Corp., San Diego, CA.
EDGE EFFECTS DURING DIII-D DIVERTOR BIASING
M. J. Schaffer, K. L. Greene, R. J. Groebner, F. L. Hinton, A. W. Hyatt, L. L. Lao, J. A. Leuer, S. I. Lippmann, M. A. Mahdavi, and T. H. Osborne et al Sep. 1992 26 p Presented at the International Atomic Energy Agency (IAEA) Technical Committee Meeting on Tokamak Plasma Biasing, Montreal (Canada), 8-10 Sep. 1992
(Contracts DE-AC03-89ER-51114; DE-FG03-89ER-51121; W-7405-eng-48; DE-AC04-76DP-00789; DE-AC03-89ER-53277)
(DE93-005847; GA-A-21064; CONF-9209181-5) Avail: CASI HC A03/MF A01

Results of experiments with a toroidal ring bias electrode in contact with the single-null diverter scrape-off layer (SOL) in the DIII-D tokamak are reviewed, and new results and analysis are presented. Topics included are: current flow in the SOL and diverter private flux; SOL density resistance; driven SOL and diverter E x B plasma flows; bias-aided diverter exhaust; SOL density control and impurity shielding; ELM effects on SOL electrical circuit; diverter and SOL heat flux modification; effect of DIII-D formation by the magnetized divertor electrode. DOE

N93-24328# Oak Ridge National Lab., TN.
AN ICRF ANTENNA EDGE PLASMA DENSITY PROFILE DIAGNOSTIC FOR DIII-D
T. S. Bigelow, G. R. Hanson, R. L. Livesey, J. B. Wilgen, I. Collazo, E. J. Doyle (California Univ., Los Angeles.), T. Rhodes (California Univ., Los Angeles.), J. Degrassie (General Atomics Technologies Corp., San Diego, CA.), and R. Phelps (General Atomics Technologies Corp., San Diego, CA.) 1992 22 p Presented at the 17th Annual Society of Photo-optical Instrumentation Engineers International Conference on Infrared and Millimeter Wave Sources, Pasadena, CA, 14-18 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-006729; CONF-921217-4) Avail: CASI HC A03/MF A01

This report discusses the following topics: microwave reflectometry; reflectometry on DIII-D; a ICRF antenna mounted reflectometer antenna system for DIII-D; DIII-D plasma profile simulation; reflectometer antenna and waveguide fabrication; performance measurements; planned measurements with the UCLA reflectometer electronics; and proposed future measurements using the ORNL TFTR reflectometer system. DOE

N93-24452# Cornell Univ., Ithaca, NY.
THEORETICAL STUDIES ON PLASMA HEATING AND CONFINEMENT
R. N. Sudan Jan. 1993 7 p
(Contract DE-FG02-84ER-53174)
(DE93-007617; DOE/ER-53174/T1) Avail: CASI HC A02/MF A01

Three principal topics are covered in this final report: Stabilization of low frequency modes of an axisymmetric compact torus plasma confinement system, such as, spheromaks and FRC'S, by a population of large orbit axis encircling energetic ions. Employing an extension of the 'energy principle' which utilizes a Vlasov description for the energetic 'ion component, it has been demonstrated that short wavelength MHD type modes are stabilized while the long wavelength tilt and precessional modes are marginally stable. The deformation of the equilibrium configuration by the energetic ions results in the stabilization of the tilt mode for spheromaks. Formation of Ion Rings and their coalescence with spheromaks. A two dimensional electromagnetic PIC codes has been developed for the study of ion ring formation and its propagation, deformation and slowing down in a cold plasma. It has been shown that a ring moving at a speed less than the Alfven velocity can merge with a stationary spheromak. Anomalous transport from drift waves in a Tokamak. The Direct Interaction Approximation in used to obtain incremental transport coefficients for particles and heat for drift waves in a Tokamak. It is shown that the transport matrix does not obey Onsager's principle. DOE

N93-24465# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
TRITIUM PERMEATION MODEL FOR PLASMA FACING COMPONENTS
G. R. Longhurst Dec. 1992 45 p
(Contract DE-AC07-76ID-01570)
(DE93-007044; EGG-FSP-10609) Avail: CASI HC A03/MF A01

This report documents the development of a simplified one-dimensional tritium permeation and retention model. The model makes use of the same physical mechanisms as more sophisticated, time-transient codes such as implantation, recombination, diffusion, trapping and thermal gradient effects. It takes advantage of a number of simplifications and approximations to solve the steady-state problem and then provides interpolating functions to make estimates of intermediate states based on the steady-state solution. The model is developed for solution using commercial spread-sheet software such as Lotus 123. Comparison calculations are provided with the verified and validated TMAP4 transient code with good agreement. Results of calculations for the ITER CDA diverter are also included. DOE

N93-24504# Wisconsin Univ., Madison.
POLOIDAL VARIATION OF VISCOUS FORCES IN THE BANANA COLLISIONALITY REGIME
J. P. Wang and J. D. Callen Dec. 1992 27 p
(Contract DE-FG02-86ER-53218)
(DE93-006822; UW-CPTC-92-6) Avail: CASI HC A03/MF A01

The poloidal variation of the parallel viscous and heat viscous forces are determined for the first time using a rigorous Chapman-Enskog-like approach that was developed recently. It is shown that the poloidal variation is approximately proportional to the poloidal distribution of the trapped particles, which are concentrated on the outer edge (large major radius side) of the tokamak. DOE

N93-24516# California Univ., Santa Barbara. Dept. of Chemical and Nuclear Engineering.
DAMAGE ANALYSIS AND FUNDAMENTAL STUDIES FOR FUSION REACTOR MATERIALS DEVELOPMENT
G. R. Odette and G. E. Lucas 11 Jan. 1993 7 p
(Contract DE-FG03-87ER-52143)
(DE93-008283; DOE/ER-52143/T2) Avail: CASI HC A02/MF A01

During this period work has encompassed: (1) development of electropotential drop techniques to monitor the growth of cracks in steel specimens for a variety of specimen geometries; (2) micromechanical modeling of fracture using finite element calculations of crack and notch-tip stress and strain fields; (3) examining helium effects on radiation damage in austenitic and ferritic stainless steels; (4) analysis of the degradation of the mechanical properties of austenitic stainless steels for the purpose of assessing the feasibility of using these steels in ITER; (5) development of an integrated approach to integrity assessment; and (6) development of advanced methods of measuring fracture properties. DOE

N93-24606# Georgia Inst. of Tech., Atlanta. Fusion Research Center.
EFFECT OF A POLOIDAL ELECTRIC FIELD ON NEOCLASSICAL TRANSPORT IN A MULTISPECIES TOKAMAK PLASMA
K. Indireshkumar and W. M. Stacey Dec. 1992 57 p
(PB93-146215; GTFR-106) Avail: CASI HC A04/MF A01

The effects of a poloidal potential variation of order epsilon, which is likely to be produced during high power cyclotron wave heating or neutral beam injection, upon neoclassical particle transport and plasma current are studied theoretically for a realistic tokamak plasma with significant impurity content. Using an approximate collision operator, an analytic procedure is employed to calculate the transport coefficients in the low collisionality regime for a large aspect ratio tokamak. In the presence of carbon impurity, the ion diffusion coefficients are generally found to increase by a factor of about 2. Inclusion of the effects of a poloidal electric field is found to result in an increase in the bootstrap current if the potential on the outside of the tokamak is greater than that on the inside (as during ICRH or NBI) and the density profiles are more peaked than roughly the square root of the temperature profiles. GRA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N93-22051# Northeastern Univ., Boston, MA. Dept. of Physics.
POSITRON STUDIES OF DEFECTED METALS, METALLIC SURFACES
A. Bansil 1991 20 p
(Contract DE-FG02-85ER-45223)
(DE93-006089; DOE/ER-45223/1) Avail: CASI HC A03/MF A01

Specific problems proposed under this project included the treatment of electronic structure and momentum density in various disordered and defected systems. Since 1987, when the new high-temperature superconductors were discovered, the project focused extensively on questions concerning the electronic structure and Fermiology of high-(Tc) superconductors, in particular, (1) momentum density and positron experiments, (2) angle-resolved photoemission intensities, and (3) effects of disorder and substitutions in the high-(Tc)'s. The specific progress made in each of these problems is summarized. DOE

N93-22062# Argonne National Lab., IL.
OSCILLATORY INTERLAYER MAGNETIC COUPLING OF SPUTTERED Fe/Nb SUPERLATTICES
J. E. Mattson, E. E. Fullerton, C. H. Sowers, Y. Y. Huang, G. P. Felcher, and S. D. Bader Sep. 1992 13 p Presented at the Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-004191; ANL/CP-76458; CONF-921201-11) Avail: CASI HC A03/MF A01

The saturation field of sputtered Fe/Nb superlattices oscillates as a function of the Nb thickness with a periodicity of approximately 9 A. In contrast to the case of Fe/Cr superlattices, the concurrent magnetoresistance oscillations were found to be very weak. Yet polarized neutron reflection measurements confirm that the Fe/Nb superlattices with high saturation field possess a magnetic ground state of the + - + - type. Neutron and x-ray measurements indicate that, while the crystalline and antiferromagnetic order is well developed along the thickness of the film, the average lateral size of the crystallites (as well as of the magnetic domains) is quite small. This effect (thought to be related to the gross mismatch of the iron and the niobium crystal lattices) may be the cause of the high overall resistance of the material, and its weak dependence on the magnetization. DOE

N93-22064# Argonne National Lab., IL.
MAGNETIC DECOUPLING IN SPUTTERED Fe/Si SUPERLATTICES AND MULTILAYERS
E. E. Fullerton, J. E. Mattson, S. R. Lee, C. H. Sowers, Y. Y. Huang, G. Felcher, S. D. Bader, and F. T. Parker Sep. 1992 14 p Presented at the Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992

(Contract W-31-109-eng-38)
(DE93-004204; ANL/CP-76457; CONF-921201-10) Avail: CASI HC A03/MF A01

A series of sputtered Fe/Si superlattices was grown to study the magnetic coupling between ferromagnetic Fe layers (30 A thick) for Si spacer-layer thicknesses (t(sub Si)) between 10 and 40 A. The material is ferromagnetically coupled for t(sub Si) less than 13 A and antiferromagneticly coupled for 13 A less than t(sub Si) less than 17 A. For t(sub Si) greater than 17 A, the magnetic Fe layers are uncoupled. The x-ray analysis indicates that the system is well layered, but that the crystal structure remains coherent only for t(sub Si) less than 17 A. These results, along with our Moessbauer investigation, strongly suggest that the Si layer is crystalline for t(sub Si) less than 17 A, and is iron silicide in nature. For thicker spacers, Si becomes amorphous. We propose a model of the layering that is consistent with the known properties of Fe-silicide. DOE

N93-22078# Argonne National Lab., IL. Materials and Components Technology Div.
PROCESSING AND MICROSTRUCTURAL DEVELOPMENT OF Ag-CLAD Bi-Sr-Ca-Cu-O TAPES
R. B. Poeppel, K. C. Goretta, U. Balachandran, A. C. Biondo, S. E. Dorris, S. C. Hathcox, D. Y. Kaufman, M. T. Lanagan, B. C. Prorok, and C. T. Wu et al Oct. 1992 5 p Presented at the 5th US/Japan Workshop on High Tc Superconductors, Tsukuba, Japan, 9-10 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-004201; ANL/MCT/CP-76909; CONF-9211144-1) Avail: CASI HC A01/MF A01

Ag-clad Bi2Sr2CaCu2O(x)(2212) and (Bi,Pb)2Sr2Ca2Cu3O(x)(2223) tapes were fabricated by drawing and rolling. Highly textured microstructures and high critical current density values were obtained for each system. However, the heat treatments and phase evolutions for 2212 and 2223 were different. For 2212, nearly phase-pure powder was used, and the heat treatments consisted of partial melting followed by solid-state sintering. For 2223, several compositions, initial phases, and sintering schedules were used. Results are discussed in terms of microstructural evolution as observed by X-ray diffraction and scanning and transmission electron microscopy. DOE

N93-22324# Sandia National Labs., Albuquerque, NM.
CHEMICALLY PREPARED Pb(Zr,Ti)O3 THIN FILMS: THE EFFECTS OF ORIENTATION AND STRESS
B. A. Tuttle, J. A. Voigt, D. C. Goodnow, R. W. Schwartz, D. L. Lamppa, T. J. Headley, M. O. Eatough, and T. J. Garino 1992 18 p Presented at the 8th IEEE International Symposium on Applications of Ferroelectronics, Greenville, SC, 30 Aug. - 2 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE93-004501; SAND-92-2111C; CONF-9208197-1) Avail: CASI HC A03/MF A01

The effects that orientation and stress have on chemically prepared Pb(Zr,Ti)0(3)(PZT) film properties are determined. Systematic modification of the underlying substrate technology has permitted us to fabricate suites of films that have various degrees of orientation at a constant stress level, and to also fabricate films that are in different states of stress, but have similar orientation. Highly oriented films of the following compositions were fabricated: PZT 60/40, PZT 40/60, and PZT 20/80. Remanent polarizations (approximately 60 microC/sq cm) greater than the best bulk polycrystalline ferroelectrics were obtained for PZT 40/60 films that were under compression and highly (001) oriented. While it was shown that systematically varying orientation influences ferroelectric properties, film stress also has a considerable effect. Perhaps the most important concept is that the sign of the film stress at the Curie point controls the type of ferroelectric behavior exhibited by PZT thin films. Further, the stress measurements as a function of thermal history indicate that the coefficient of thermal expansion of the paraelectric state is critical in determining the type of film ferroelectric behavior. DOE

N93-22336# Midwest Research Inst., Golden, CO.
POLYCRYSTALLINE THIN FILMS Project Report, FY 1992
K. Zweibel, ed. Jan. 1993 20 p
(Contract DE-AC02-83CH-10093)
(DE93-000070; NREL/TP-413-5270) Avail: CASI HC A03/MF A01

This report summarizes the activities and results of the Polycrystalline Thin Film Project during FY 1992. The purpose of the DOE/NREL PV (photovoltaic) Program is to facilitate the development of PV that can be used on a large enough scale to produce a significant amount of energy in the US and worldwide. The PV technologies under the Polycrystalline Thin Film Project are among the most exciting 'next-generation' options for achieving this goal. Over the last 15 years, cell-level progress has been steady, with laboratory cell efficiencies reaching levels of 15 to 16 percent. This progress, combined with potentially inexpensive manufacturing methods, has attracted significant commercial interest from US and international companies. The NREL/DOE program is designed to support the efforts of US companies through cost-shared subcontracts (called government/industry partnerships) that we manage and fund and through collaborative technology development work among industry, universities, and our laboratory. DOE

N93-22342# Los Alamos National Lab., NM.
EVOLUTION AND DYNAMICS OF EXCIMER LASER VAPORIZED YBa2Cu3O(7-DELTA) PLUMES
R. C. Dye, R. Brainard, S. R. Foltyn, R. E. Muenchausen, Xin-Di Wu, and N. S. Nogar 1992 13 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-7405-eng-36)
(DE93-005474; LA-UR-92-4260; CONF-921101-49) Avail: CASI HC A03/MF A01

Pulsed laser deposition of thin films is a technology whose fundamental processes are often poorly understood. Because of the difficulty of monitoring in real time either the ablation process itself (the laser-solid interaction), or thin film growth (plume-substrate interaction), studies have largely relied on diagnostic studies of the ablated plume and the resulting film to infer details about other steps in the process. Information gained from this approach has helped improve the production of high-temperature superconducting thin films. We have studied plume dynamics during the in-situ pulsed laser deposition of YBa2Cu3O(7-delta) thin films. The 248 and 308 nm lines of an excimer laser were used to generate a plume from a bulk YBa2Cu3O(7-delta) target. Both fast intensified CCD imaging and spectral diagnostics were used to monitor plume dynamics. Variations in the plume distribution as a function of processing gas, pressure, fluence, energy, and spot size were monitored by film composition and spectral- and time-resolved imaging. DOE

N93-22344# Argonne National Lab., IL.
IMPLICATIONS OF DEFECT CLUSTERS FORMED IN CASCADES ON FREE DEFECT GENERATION AND MICROSTRUCTURAL DEVELOPMENT
H. Wiedersich Dec. 1992 28 p Presented at the 3rd Conference on Evolution of Microstructure in Metals During Irradiation, Chalk River, Ontario, 29 Sep. - 2 Oct. 1992
(Contract W-31-109-eng-38)
(DE93-005551; ANL/MSD/CP-78287; CONF-920970-6) Avail: CASI HC A03/MF A01

A large fraction of the defects produced by irradiation with energetic neutrons or heavy ions originates in cascades. Not only increased recombination of vacancy and interstitial defects but also significant clustering of like defects occur. Both processes reduce the number of point defects available for long range migration. Consequences of defect clustering in cascades will be discussed in a semi-quantitative form with the aid of calculations using a very simplified model: Quasi-steady-state distributions of immobile vacancy and/or interstitial clusters develop which, in turn, can become significant sinks for mobile defects, and, therefore, reduce their lifetime. Although cluster sinks will cause segregation and, potentially, precipitation of second phases due to local changes of composition, the finite lifetime of clusters will not lead to lasting, local compositional changes. A transition from highly dense interstitial and vacancy cluster distributions to the void swelling regime occurs when the thermal evaporation of vacancies from small vacancy clusters becomes significant at higher temperatures. Unequal clustering of vacancies and interstitials leads to an imbalance of their fluxes of in the matrix and, hence, to unequal contributions to atom transport by interstitials and by vacancies even in the quasi-steady state approximation. DOE

N93-22420# California Univ., Berkeley. Lawrence Berkeley Lab.
METALLIZATION AND INSULIZATION DURING IMPACT

J. J. Gilman Oct. 1992 12 p Presented at the Hypervelocity Impact Symposium, Austin, TX, 17-20 Nov. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004708; LBL-33020; CONF-921162-15) Avail: CASI HC A03/MF A01

It is pointed out that the large strains produced by hypervelocity impacts can be expected to produce dramatic changes in the chemical bonding (electronic structures) of materials. This will change the mechanical behavior towards increased ductility when a semiconductor is compressed until it becomes metallic; and towards increased brittleness when a transition metal is expanded so as to localize its d-band electrons. Both isotropic compression (expansion) and shear strains can cause these transformations. Critical deformation criteria are given based on the observed cubic to tetragonal transformations in compressed semiconductors. DOE

N93-22429# International School for Advanced Studies, Trieste (Italy).
LOCAL VIBRONIC AND ELECTRONIC EXCITATIONS OF DOPING-INDUCED STATES IN THE COPPER OXIDES
K. Yonemitsu, A. R. Bishop, and J. Lorenzana (International School for Advanced Studies, Trieste, Italy.) 1992 11 p Presented at the 2nd Cinvestav Superconductivity Symposium, Tequisquiapan, Mexico, 2-6 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003844; LA-UR-92-3808; CONF-9211133-1) Avail: CASI HC A03/MF A01

Doping states in the copper oxides are investigated in a two-dimensional, three-band Peierls-Hubbard model. We consider displacements of planar O atoms along the Cu-O bonds, and focus on intersite electron-phonon interactions modifying the hopping integral between the Cu and O orbitals. Hartree-Fock configurations of polaronic states in the antiferromagnetic background are sensitively affected by weak electron-phonon interaction. Vibronic and optical excitation spectra, obtained with the random phase approximation, contain doping-induced structures caused by excitation modes localized around the polarons. A dimensionless strength of the electron-phonon interaction is deduced from a comparison with recent generalized inhomogeneous LDA calculations. The nature of doping states is quite different from that described within purely electronic, Hubbard, and t-J models. DOE

N93-22492# California Univ., Berkeley. Lawrence Berkeley Lab.
APPLICATIONS OF TEM TO INTERFACE IN MATERIALS
U. Dahmen Sep. 1992 4 p Presented at the 3rd MICROMAT, Rio de Janeiro, Brazil, 28-30 Oct. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004776; LBL-32932; CONF-9210259-1) Avail: CASI HC A01/MF A01

While surfaces have been investigated by scattering techniques and scanning probe microscopies, the major tool for investigating the structure of internal interfaces has been transmission electron microscopy (TEM). Several examples of interfacial structure analysis by TEM are given; they cover Si/Al and Al/Ge. DOE

N93-22493# Argonne National Lab., IL.
ELECTRONIC STRUCTURE STUDIES OF YBa2Cu3O(x)(6.2 LESS THAN EQUAL TO X LESS THAN OR EQUAL TO 6.9) USING ANGLE RESOLVED PHOTOEMISSION
B. W. Veal, Rong Liu, A. P. Paulikas, D. D. Koelling, J. W. Downey, Hao Shi (Missouri Univ., Kansas City.), and C. G. Olson (Ames Lab., IA.) Nov. 1992 49 p Presented at the 10th International Summer Institute in Surface Science (ISISS) Meeting, Milwaukee, WI, 29 Jun. - 2 Jul. 1992
(Contracts W-31-109-eng-38; W-7405-eng-82)
(DE93-004811; ANL/MSD/CP-77995; CONF-9206332-1) Avail: CASI HC A03/MF A01

Using high resolution angle resolved photoemission, the electronic structure of YBa2Cu3O(x) is examined when oxygen stoichiometries are varied in the range 6.2 less than or equal to x less than or equal to 6.9. Detailed measurements of the Fermi surface for YBa2Cu3O(6.9) are presented and are compared with predictions of band theory. In the metallic region of the phase diagram, changes in the Fermi surfaces are measured as a function of oxygen stoichiometry. The electronic structure is monitored as the oxide changes from a metal to a semiconductor with additional oxygen depletion. For intermediate stoichiometries, effects of oxygen vacancy ordering are considered. Unusual resonant effects observed at several photon energies are examined as oxygen content is varied. DOE

N93-22497# Oak Ridge National Lab., TN.
FLUX PINNING STRUCTURES IN MELT-PROCESSED YBa2Cu3O(7-x)
D. M. Kroeger, Z. L. Wang, and A. Goyal 1992 5 p Presented at the 5th United States/Japan Workshop on High Tc Superconductors, Tsukuba (Japan), 9-10 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005151; CONF-9211144-5) Avail: CASI HC A01/MF A01

Microstructural examination of melt-processed YBa2Cu3O(7-x) has revealed the presence of a high density of stacking faults in the 123 surrounding entrapped 211 particles. Estimates of their pinning effectiveness and density suggest that dislocation loops bounding these stacking faults may explain the increase in J(sub c) in melt-processed material with 211/123 interfacial area. DOE

N93-22503# Sandia National Labs., Albuquerque, NM.
ADVANCED DIELECTRICS FOR PASSIVATION OF InSb
J. C. Barbour, S. A. Casalnuovo, and S. R. Kurtz 1992 6 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005353; SAND-92-1593C; CONF-921101-47) Avail: CASI HC A02/MF A01

A combination of Electron Cyclotron Resonance (ECR) plasma, electrochemical, and chemical growth process were examined to synthesize dielectric surface passivation layers on InSb. The material properties of ECR-grown SiO(x)N(y) on InSb at temperatures from 30 C to 250 C were investigated. Composition analysis was done using Rutherford backscattering spectrometry (RBS) and elastic recoil detection (ERD). The electrical quality of the passivation layer was characterized with capacitance-voltage (CV) measurements on metal-insulator-semiconductor structures over the frequency range from 1 kHz to 1 MHz. Sulfided layers, Si3ON2 on InSb, and sulfided layers capped with Si3ON2 all exhibited good C-V properties consistent with interface state densities on the order of 10(exp 11)/cm(exp 2)-eV, and flatband voltages of magnitude less than 1 V. The difference in adhesion of Si3N4 on InSb and the adhesion of Si3ON2 on InSb was described in terms of the strength of the bonding at the dielectric-InSb interface. This work is the first to demonstrate passivation of an InSb surface with high-quality ECR silicon oxynitrides grown at room temperature. DOE

N93-22508# Oak Ridge National Lab., TN.
A VIBRATIONAL ANALYSIS OF Au IMPLANTED Al2O3 SINGLE CRYSTALS: ION AND THERMAL ANNEALING EFFECTS
D. O. Henderson, S. H. Morgan, R. Mu, N. Chen (Fisk Univ., Nashville, TN.), R. H. Magruder, III (Vanderbilt Univ., Nashville, TN.), C. W. White, and R. A. Zuhr 1992 6 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-006216; CONF-921101-67) Avail: CASI HC A02/MF A01

The implantation of Au into Al2O3 leads to disruption of the crystal order, producing an amorphous layer. Annealing the implanted crystals at 1373 K restores the crystallinity and also imparts a purple color to the implanted layer which is attributed to a surface plasmon resulting from the formation of Au colloids. DOE

N93-22510# Lawrence Livermore National Lab., CA.
THE NUCLEATION AND GROWTH OF URANIUM ON THE BASAL PLANE OF GRAPHITE STUDIED BY SCANNING TUNNELING MICROSCOPY Ph.D. Thesis
R. J. Tench Nov. 1992 62 p
(Contract W-7405-eng-48)
(DE93-006279; UCRL-LR-112417) Avail: CASI HC A04/MF A01

For the first time, nanometer scale uranium clusters were created on the basal plane of highly oriented pyrolytic graphite by laser ablation under ultra-high vacuum conditions. The physical and chemical properties of these clusters were investigated by scanning tunneling microscopy (STM) as well

as standard surface science techniques. Auger electron and X-ray photoelectron spectroscopies found the uranium deposit to be free of contamination and showed that no carbide had formed with the underlying graphite. Clusters with sizes ranging from 42 to 630 sq A were observed upon initial room temperature deposition. Surface diffusion of uranium was observed after annealing the substrate above 800 K, as evidenced by the decreased number density and the increased size of the clusters. Preferential depletion of clusters on terraces near step edges as a result of annealing was observed. The activation energy for diffusion deduced from these measurements was found to be 15 Kcal/mole. Novel formation of ordered uranium thin films was observed for coverages greater than two monolayers after annealing above 900 K. These ordered films displayed islands with hexagonally faceted edges rising in uniform step heights characteristic of the unit cell of the P-phase of uranium. In addition, atomic resolution STM images of these ordered films indicated the formation of the (beta)-phase of uranium. The chemical properties of these surfaces were investigated and it was shown that these uranium films had a reduced oxidation rate in air as compared to bulk metal and that STM imaging in air induced a polarity-dependent enhancement of the oxidation rate. DOE

N93-22523# Argonne National Lab., IL.
MAGNETIC COUPLING OF Fe/Mo/Fe AND Co/Cu/Co SANDWICHES ACROSS WEDGED SPACER LAYERS
Z. Q. Qiu, J. Pearson, and S. D. Bader Sep. 1992 25 p Presented at the Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-004203; ANL/CP-76470; CONF-921201-12) Avail: CASI HC A03/MF A01

Fe/Mo/Fe and Co/Cu/Co sandwiches were grown by molecular beam epitaxy onto Mo(100) and Cu(100) single crystals, respectively, and characterized by high- and low-energy electron diffraction and in-situ surface magneto-optic Kerr-effect measurements. The spacer layer in both case was fabricated to have a wedged shape in order to create a continuous change of the spacer-layer thickness. Oscillatory behavior between ferromagnetic and antiferromagnetic coupling was found; and is shown to originate at the interface between the magnetic layer and the spacer layer. For Fe/Mo/Fe, short-period oscillations are observed with a periodicity of approximately 3ML of Mo. Hysteresis loops for antiferromagnetically coupled cases are calculated from a simple model; results reproduce the general characteristics observed experimentally. DOE

N93-22526# Michigan Univ., Ann Arbor.
SYNCHROTRON STUDIES OF NARROW BAND MATERIALS
J. W. Allen 1993 29 p
(Contract DE-FG02-90ER-45416)
(DE93-006981; DOE/ER-45416/3) Avail: CASI HC A03/MF A01

The objective was to determine the single-particle electronic structure of selected narrow band materials in order to understand the relation between their electronic structures and novel low energy properties, such as mixed valence, heavy Fermions, Kondo effect, insulator-metal transitions, non-Fermi liquid behavior, and high-temperature superconductivity. This program supports photoemission spectroscopy (PES) at various synchrotrons. The progress is reported under the following section titles: ZSA (Zaanen-Sawatzky-Allen) systematics and I-M transitions in 3d transition metal oxides; insulator-metal transitions in superconducting cuprates; Fermi liquid and non-Fermi liquid behavior in angular resolved PES lineshapes; heavy-Fermion and non-Fermi liquid 5f electron systems; and Kondo insulators. DOE

N93-22538# Oak Ridge National Lab., TN.
INVESTIGATION OF THE KINETICS OF SURFACE-LIMITED THIN FILM GROWTH OF SiGe ALLOYS
J. W. Sharp (Tennessee Univ., Knoxville.) and G. Eres Nov. 1992 6 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005419; CONF-921101-36) Avail: CASI HC A02/MF A01

The kinetics of surface-limited thin film growth of SiGe alloys was investigated by time-resolved surface differential reflectometry. The source gas, mixtures of disilane and digermane in ratios from 1:1 to 6:1 in helium carrier gas, was delivered to a heated substrate by a fast-acting pulsed molecular jet valve. The adsorption and desorption kinetics were determined from the surface differential reflectance signal obtained using a polarized, high-stability HeNe probe laser. Thin film growth was studied in the temperature range of 400-600 C on Si(001) substrates. Preferential incorporation of digermane into the film produces an alloy composition that depends upon but does not mirror the gas composition. For all gas mixtures, there is a strong temperature dependence of the rate at which the adsorption layer decomposes into film plus by-product. The kinetic data and the alloy compositions provide a basis for deducing some of the characteristics of the reaction sequence that leads to SiGe alloy thin film growth. DOE

N93-22548# Illinois Univ., Urbana.
SIMULATION OF ELECTRONIC TRANSPORT IN SEMICONDUCTOR HETEROLAYER DEVICES Final Report, 1989 - 1992
Karl Hess 10 Oct. 1992 7 p
(Contract DAAL03-89-K-0037)
(AD-A260122; ARO-26711.22-EL) Avail: CASI HC A02/MF A01

A brief summary of research accomplishments during the past three years is given. Details are covered by the six submitted technical reports and twenty papers published in referred journals. The topics covered include the following: semiconductors, heterostructures, devices, and electron transport simulation. GRA

N93-22549# Aerospace Corp., El Segundo, CA.
METALLO-ORGANIC SOLUTION DEPOSITION OF FERROELECTRIC PZT FILMS
Russell A. Lipeles, Martin S. Leung, and Dianne J. Coleman 9 Sep. 1992 30 p
(Contract F04701-88-C-0089)
(AD-A260127; TR-0090(5945-02)-1; SMC-TR-92-42) Avail: CASI HC A03/MF A01

The metallo-organic solution deposition ((MOSD) or sol-gel) technique can be used for preparing lead zirconate titanate (PZT) ceramics with a wide range of compositions and crystal structures for electro-optical applications. Film morphology is affected by stoichiometry of the film, hydrolysis and polymerization of the sol-gel solution, and thermal treatment of the deposited material. The lattice parameter decreases with the amount of titanium in PZT in agreement with ceramic data. A slight initial excess of lead in the coating solution is found to improve film morphology. Unlike traditional powder ceramic processing techniques, MOSD permits the growth of small uniform grains that are conducive to achieving consistent electronic and optical properties. Our results show that the properties of films prepared by the MOSD process can be tailored to meet the needs of device applications. GRA

N93-22725# Ames Lab., IA.
GROWTH OF PRECIPITATES IN Bi2Sr2CaCu2O8
M. Xu, J. Polonka, A. I. Goldman, D. K. Finnemore, and S. McKernan 1992 8 p Presented at the 3rd International Conference and Exhibition of the World Congress on Superconductivity, Munich, Germany, 14-19 Sep. 1992
(Contract W-7405-eng-82)
(DE93-004443; IS-M-729; CONF-920916-3) Avail: CASI HC A02/MF A01

In the formation of Bi2Sr2CaCu2O8 from a Ca and Cu rich melt, the partial pressure of oxygen is a central factor controlling the phases that form as precipitates in the host superconductor. At a high oxygen pressure, a sample with a stoichiometry of Bi2Sr2Ca2Cu3O10 will form (Sr,Ca)2CuO3 as the dominant precipitate coexisting with the liquid from which Bi2Sr2CaCu2O8 forms. During the crystallization of Bi2Sr 2CaCu2O8 from this liquid, part of the (Sr,Ca)2CuO3 phase is consumed. By contrast, at low oxygen partial pressure a sample with the same stoichiometry will form CaO as the dominant precipitate coexisting with the liquid from which Bi2Sr2CaCu2O8 forms. In this case, some of the CaO is consumed and a Ca rich (Sr,Ca)2CuO3 phase forms during the Bi2Sr 2CaCu2O8 crystallization. Oxygen partial pressure is a key factor controlling the sequence of precipitates that form in the host superconductor. The precipitate can serve as pinning sites for magnetic flux. DOE

N93-22726# Ames Lab., IA.
PHASE DIAGRAM EFFECTS IN RAPID THERMAL PROCESSING OF REBa2Cu3O(7-DELTA)
R. W. McCallum, M. J. Kramer, and S. T. Weir (California Univ., Livermore. Lawrence Livermore Lab.) 24 Aug. 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-7405-eng-82)
(DE93-004445; IS-M-733; CONF-920802-41) Avail: CASI HC A01/MF A01

Recent investigations of rapid thermal processing of REBa2Cu3O(7-delta) by drop tube melting, laser surface treatment and shock compaction have shown that the microstructure resulting from these processes is a complex mixture of non-equilibrium phases. While it is tempting to ascribe the variations in microstructure to variations in quench rates between the processes, we will demonstrate that with the exception of extremely rapid solidification from above the liquidus, the microstructure and phase distribution results from the heating rather than the cooling part of the curve. Since all of the above processes induce non-uniform heating, different parts of the sample reach different maximum temperatures. The maximum temperature reached, and the time spent near that maximum, uniquely determine the starting state of the quench. If the entire sample is not above the liquidus the sluggishness of the peritectic reactions results in similar microstructure regardless of the quench rate. Upon annealing the final microstructure is much more dependent on the number of nucleation sites than on the type of site resulting in a uniform REBa2Cu3O(7-delta) microstructure over a broad range of processing parameters. DOE

N93-22728# Ames Lab., IA.
CRITICAL CURRENT ENHANCEMENT BY NEUTRON IRRADIATION OF RAPIDLY TEXTURED BiSr2CaCu2O8
M. J. Kramer, S. R. Arrasmith, R. W. McCallum, and J. W. Farmer 24 Aug. 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contracts W-7405-eng-82; DE-FG02-90ER-45427)
(DE93-004453; IS-M-731; CONF-920802-39) Avail: CASI HC A01/MF A01

We have investigated the effect of fast neutron irradiation on c-axis aligned Bi2Sr2CaCu2O8 (Bi2212) produced using a new technique. Amorphous Bi2212 was crystallized under 20 MPa uniaxial stress at 870 C for 6 hrs. DC SQUID shows a transition onset of 90K. Material was cut into 2 x 2 x 0.150 mm slabs, sealed in quartz ampules, and irradiated at fluences of 10(exp 16), 5 x 10(exp 16), 2.5 x l0(exp 17), and 7.2 x 10(exp 17) n/sq cm. DC SQUID results show that J(sub c) is increased by a factor of 2.5 at 10K for fluences of 7.2 x 10(exp 17) for H parallel to c-axis for fields less than 3 T. The higher the fluence, the lower the dependency of J(sub c) on applied field and temperature. T(sub c) decreased by 1 K for a fluence of 2.5 x 10(exp 17) n/sq cm with an additional 2 K drop for 7.2 x 10(exp 17) n/sq cm. The increase in the width of the high field hysteresis loops for increasing fluence is more pronounced for samples measured normal to the c-axis. DOE

N93-22745# Argonne National Lab., IL.
A COMPARISON OF TWIN BOUNDARY PINNING IN NEARLY FULLY STOICHIOMETRIC AND OXYGEN DEFICIENT YBa2C((LC)U3O(7-DELTA)
S. Fleshler, W. K. Kwok, U. Welp, J. Downey, and G. W. Crabtree Nov. 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-004854; ANL/MSD/CP-78124; CONF-920802-46) Avail: CASI HC A01/MF A01

The angular dependence of the magnetoresistance was measured on the same single crystal of a YBa2Cu3O(7-delta) prepared initially with a superconducting transition temperature of 93.0K and then annealed to obtain a transition temperature of 56.9K. A second oxygen deficient sample was produced with a transition temperature 57.0K and nearly identical transport characteristics. Twin boundary pinning superimposed on flux flow behavior was observed in both the 56.9K and 93.0K states for magnetic field rotation in ab plane. For magnetic field rotations off the c axis we observe twin boundary pinning only for the nearly stoichiometric state. We find the broadening of the resistive transition in magnetic field (H parallel c) to occur over a much larger interval of reduced temperature in the deoxygenated state. The enhanced broadening of the resistive transition in magnetic field and absence of twin boundary pinning may indicate that the vortex system is two dimensional and in general, defects are rendered ineffective in pinning due to the absence of three dimensional collective elastic effects. DOE

N93-22747# Los Alamos National Lab., NM.
A STRUCTURAL STUDY OF CHARGE-DENSITY-WAVE PERTURBATIONS IN MIXED-HALIDE MX SOLIDS
Brian Scott, Sabina R. Johnson, and Basil I. Swanson 1992 7 p Presented at the 1992 International Conference on Science and Technology of Synthetic Metals (ICSM), Goeteborg, Sweden, 12-18 Aug. 1992
(Contract W-7405-eng-36)
(DE93-005449; LA-UR-92-4030; CONF-9208132-9) Avail: CASI HC A02/MF A01

Mixed-halide crystals have been formed by co-crystallizing pure (Pt(en)2Cl2)(Pt(en)2)(ClO4)4(PtCl) and (Pt(en)2I2)(Pt(en)2)(ClO4)4(PtI), where en = 1,2 diaminoethane. Single crystal x-ray diffraction reveals that these crystals are of high quality. The pure PtI and PtCl contain chains of alternating Pt and halogen atoms that have undergone a Peierls distortion and commensurate charge disproportionation, resulting in alternating valence states on the platinum atoms: X-Pt(IV)-X---Pt(II)---X. The Peierls distortion results in a charge-density-wave (CDW), the strength of which is measured as the ratio, rho, of the short Pt(IV)-X bond distance to the long Pt(II)---X bond distance. PtCl is a strong CDW system with rho = 0.750 and PtI is a weak CDW system with rho = 0.919. The mixed-halide systems have the stoichiometry PtCl(1-x)I(x), with x = 0.1, 0.15, 0.2, 0.3, 0.7, 0.8, 0.85, and 0.90. A Chain lattice constant versus composition study strongly suggests distorted PtI and PtCl chains in these solids. A single crystal diffraction study on PtCl(0.85)I(0.15) shows significant perturbations in the PtCl and PtI chain CDW strengths, with the PtI segment showing no Peierls distortion (rho = 1). This control of the CDW strength, which is strongly tied to electron-electron and electron-phonon interactions in these solids, potentially allows tuning of electronic and optical properties on a nanometer scale. DOE

N93-22748# Los Alamos National Lab., NM.
FAR-INFRARED AND RESONANCE RAMAN SPECTROSCOPY AND ISOTOPIC SUBSTITUTION STUDIES OF HALOGEN-BRIDGED PLATINUM CHAIN SOLIDS
S. P. Love, L. A. Worl, R. J. Donohoe, S. C. Huckett, S. R. Johnson, and B. I. Swanson 1992 5 p Presented at the 1992 International Conference on Science and Technology of Synthetic Metals, Goeteborg, Sweden, 12-18 Aug. 1992
(Contract W-7405-eng-36)
(DE93-005450; LA-UR-92-4029; CONF-9208132-12) Avail: CASI HC A01/MF A01

Here we review our most recent results on the vibrational spectroscopy of the MX chain solids (Pt(en)2)(Pt(en)2X2)(ClO4)4, (X = Cl, Br or I, and en = C2H8N2), referred to as PtX. Isotopic substitutions are used to clarify the nature of various vibrational modes. For Raman spectroscopy, fundamental phonon frequencies are determined, when possible, by excitation far below the band edge using a Ti:Sapphire laser, thus avoiding defect production, while photo-induced defects are studied specifically after intentional production. DOE

N93-22754# Los Alamos National Lab., NM.
ELECTRON-PHONON DRIVEN SPIN FRUSTRATION IN MULTI-BAND HUBBARD MODELS: MX CHAINS AND OXIDE SUPERCONDUCTORS
J. T. Gammel (Naval Command, Control and Ocean Surveillance Center, San Diego, CA.), K. Yonemitsu, A. Saxena, A. R. Bishop, and H. Roeder (Bayreuth Univ., Germany.) 1992 7 p Presented at the 1992 International Conference on Science and Technology of Synthetic Metals (ICSM), Goeteborg, Sweden, 12-18 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003697; LA-UR-92-3242; CONF-9208132-7) Avail: CASI HC A02/MF A01

The consequences of both electron-phonon and electron-electron couplings in 1-D and 2-D multi-band (Peierls-Hubbard) models are discussed. After a brief discussion of various analytic limits, focus is on (Hartree-Fock and exact) numerical studies in the intermediate regime for both couplings, where unusual spin-Peierls as well as long-period, frustrated ground states are found. Doping into such phases or near the phase boundaries can

lead to further interesting phenomena such as separation of spin and charge, a dopant-induced phase transition of the global (parent) phase, or real-space ('bipolaronic') pairing. Possible experimentally observable consequences of this rich phase diagram for halogen-bridged, transition metal, linear chain complexes (MX chains) in 1-D and the oxide superconductors in 2-D are discussed. DOE

N93-22808# Los Alamos National Lab., NM.
GROWTH AND CHARACTERIZATION OF LASER-DEPOSITED SUPERCONDUCTING Bi-Sr-Ca-Cu-O THIN FILMS
P. J. Kung and R. E. Muenchausen 1992 23 p Presented at the 39th National Symposium of the American Vacuum Society, Chicago, IL, 9-13 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003792; LA-UR-92-3526; CONF-921129-4) Avail: CASI HC A03/MF A01

Superconducting Bi-Sr-Ca-Cu-O thin films with thickness 400-3,500 A have been deposited on (100) MgO and (100) LaAlO3 by a pulsed excimer XeCl laser (gamma = 308 nm, tau = 20 ns, and energy density = 4-5 J/sq cm). Oxygen pressure during deposition and substrate temperature are 0.1-100 mTorr and 350-750 C, respectively. The as-deposited films were annealed either inside (in situ) or outside (ex situ) the deposition chamber to improve the crystallinity and the superconducting transition of the films. Formation of 2212 and 2223 phases was controlled by tailoring the deposition and annealing parameters. Corresponding (T(sub c))'s of these phases in the ex situ films measured by zero-field cooled diamagnetic transition at 10 Oe are 80 and 110 K; however, the in situ mirror-like shiny films with 2223 phase only exhibit (T(sub c)) = 81 K (or 98 K in an a.c. field of 0.1 Oe at 125 Hz). These films were also characterized by SEM, TEM, SQUID magnetometer, and AC susceptometer to study their morphology, microstructure, and magnetic properties. The critical magnetization current density (J(sub c)) of the ex situ films is of the order of 10(exp 7)-10(exp 8) A/sq cm and 10(exp 5)-10(exp 6) A/sq cm for H (perpendicular) c-axis and H (parallel) c-axis, respectively, at 7 K up to 5 T. The J(sub c) of the in situ films is two orders of magnitude lower than that of the ex situ films, and further enhancement of J(sub c) appears promising if better crystallinity of the in situ films can be achieved. A qualitative phase diagram with respect to the development of 2212 and 2223 phases are discussed. DOE

N93-22887# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
STRUCTURE AND DYNAMICS IN LOW DIMENSIONAL GUEST-HOST SOLIDS
J. E. Fischer Nov. 1992 8 p
(Contract DE-FG02-86ER-45254)
(DE93-006498; DOE/ER-45254/T1) Avail: CASI HC A02/MF A01

X-ray scattering was used to study thin films of C(60) on mica. Sodium intercalation into C(60) yields Na(x)C(60), with Na(6)C(60) retaining the fcc structure of undoped C(60). The fcc domain was extended up to x = 10. Metallic and superconducting donor-type intercalation compounds of C(60) are now well established; C(60)I(4) was obtained with no superconductivity above 4 K. Isothermal compressibility of K(3)C(60) and Rb(3)C(60) was measured and used to establish a universal first-order relation between (Tc) and lattice parameter a. Inelastic neutron scattering of inter- and intrachain dynamics of polyacetylene, polyaniline, and poly-parapheylene-vinylene reveal differences in the dominant thermal excitations. DOE

N93-22928# Pennsylvania State Univ., University Park.
IN-SITU CHARACTERIZATION OF GROWTH AND INTERFACES IN a-Si:H DEVICES
R. W. Collins, C. R. Wronski, I. An, and Y. Li Dec. 1992 58 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE93-000051; NREL/TP-451-5265) Avail: CASI HC A04/MF A01

This report describes the in-situ characterization of growth and interfaces in amorphous silicon (a-Si:H) devices. The growth of a-Si:H by plasma-enhanced chemical vapor deposition (PECVD) is complex and involves many gas-phase and solid-surface chemical and physical processes, which are influenced by charged particle bombardment, ultraviolet light exposure, etc. The research consisted of two broad components. The first involved preparing a-Si:H by 'optimum' PECVD and exposing the film to atomic hydrogen in-situ at the growth temperature. The processes of H-diffusion and incorporation in the exposed film were studied by spectroscopic ellipsometry, giving a picture of the processes by which the chemical potential in the film equilibrates with that in the gas phase. The properties of thin films were then prepared by alternating 'optimum' PECVD growth and hydrogen exposure. Film properties were then studied again. The second component of the research is discussed only briefly in this report, as it is an outgrowth of previous work on single-wavelength ellipsometry. With the new spectroscopic capability developed at Penn State, it is now possible to quantify the nucleation and growth process of a-Si:H films. DOE

N93-22939# Argonne National Lab., IL.
COMPUTER SIMULATION OF THE ANOMALOUS ELASTIC BEHAVIOR OF THIN FILMS AND SUPERLATTICES
D. Wolf Oct. 1992 11 p Presented at the 2nd International Conference and Exhibition on Computer Applications to Materials and Molecular Science and Engineering, Yokohama, Japan, 22-25 Sep. 1992
(Contract W-31-109-eng-38)
(DE93-004154; ANL/MSD/CP-77907; CONF-920927-1) Avail: CASI HC A03/MF A01

Atomistic simulations are reviewed that elucidate the causes of the anomalous elastic behavior of thin films and superlattices (the so-called supermodulus effect). The investigation of free-standing thin films and of superlattices of grain boundaries shows that the supermodulus effect is not an electronic but a structural interface effect intricately connected with the local atomic disorder at the interfaces. The consequent predictions that (1) coherent strained-layer superlattices should show the smallest elastic anomalies and (2) the introduction of incoherency at the interfaces should enhance all anomalies are validated by simulations of dissimilar-material superlattices. DOE

N93-22944# Argonne National Lab., IL.
SUBSTRATE SURFACE STRUCTURE EFFECTS ON MICROSTRUCTURE OF EPITAXIAL FILMS
J. Guo, H. L. M. Chang, H. Zhang, and D. J. Lam Dec. 1992 5 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-005562; ANL/MSD/CP-76433; CONF-921101-56) Avail: CASI HC A01/MF A01

Microstructure of epitaxial thin films grown on sapphire substrates using the metal organic chemical vapor deposition technique were found to depend on the substrates surface structure. Epitaxial TiO2 films grown on the sapphire (0001) substrates were highly-oriented polycrystal and the films on the (1120) substrates were single crystal. First-principles total energy calculations were carried out to gain atomistic understandings of sapphire surface structures and their effects on microstructure of epitaxial films. The surface terminating atom planes were found to be Al atoms for the (0001) surface and O atoms for the (1120). Minimum step heights were one sixth of the lattice constant c for the (0001) and one half of the lattice constant a for the (1120). Steps of minimum height or its odd multiples on sapphire (0001) surface double the number of variants in the deposited films. The symmetry and step of the substrate surface and symmetry of the epitaxial growth plane controlled the microstructure of the epitaxial films. DOE

N93-22955# Brookhaven National Lab., Upton, NY.
ION AND ELECTRON BEAM PROCESSING OF CONDENSED MOLECULAR SOLIDS TO FORM THIN FILMS
M. W. Ruckman, M. Strongin, J. K. Mowlem, J. F. Moore, and D. R. Strongin (State Univ. of New York, Stony Brook.) 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC02-76CH-00016)
(DE93-007273; BNL-48419; CONF-921101-65) Avail: CASI HC A02/MF A01

Electron and ion beams can be used to deposit thin films and etch surfaces using gas phase precursors, However, the generation of undesirable

gas phase products and the diffusion of the reactive species beyond the region irradiated by the electron or ion beam can limit selectivity. In this paper, the feasibility of processing condensed precursors such as diborane, tri-methyl aluminum, ammonia and water at 78 K with low energy (100-1000 eV) electron and ion beams (Ar(+), N2(+) and H2(+)) ranging in current density from 50 nA to several micron a per cm(exp 2) is examined. It was found that boron, boron nitride and stoichiometric aluminum oxide films could be deposited from the condensed volatile; species using charged particle beams and some of the physical and chemical aspects and limitations of this new technique are discussed. DOE

N93-22969# Xerox Palo Alto Research Center, CA.
RESEARCH ON THE STABILITY, ELECTRONIC PROPERTIES, AND STRUCTURE OF a-Si:H AND ITS ALLOYS
R. A. Street, W. B. Jackson, N. Johnson, C. Nebel, M. Hack, P. Santos, R. Thompson, C. C. Tsai, and J. Walker Dec. 1992 56 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE93-000050; NREL/TP-451-5192) Avail: CASI HC A04/MF A01

The objective is to obtain a comprehensive understanding of structure and electronic properties of a-Si:H as they apply to solar cells. First observations were of light enhancement and field suppression of H diffusion in a-Si:H. Theoretical studies were made of hydrogen density of states distribution and its relation to defect metastability. Reduced density of light induced defect is observed in a-Si:H deposited in a remote hydrogen plasma reactor at 400 C. Kinetics of metastable defect creation using forward bias in a p-i-n diode to induce defects were studied and compared to light-induced defect creation in the same devices. Studies were made of transport at high electric field and low temperature. Detailed studies were made of the kinetics of dopant metastability in n-type and p-type a-Si:H. DOE

N93-22974# Sandia National Labs., Albuquerque, NM.
GROWTH AND OPTICAL CHARACTERIZATION OF ZnMnTe GROWN BY MOLECULAR BEAM EPITAXY
J. L. Reno, E. D. Jones, and E. L. Venturini 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005350; SAND-92-2542C; CONF-921101-53) Avail: CASI HC A02/MF A01

We have successfully grown ZnMnTe alloys by molecular beam epitaxy using GaAs as a substrate. Bulk MnTe has the wurtzite crystal structure but the structural phase of the material was confirmed to be a zinc-blend by standard theta-2(theta) x-ray diffraction techniques. The composition was also determined using x-ray diffraction techniques. Manganese concentration was also estimated from magnetization measurements taken as a function of temperature. Magnetoluminescence studies were performed at 1.4K on the acceptor-bound exciton in the semimagnetic semiconductor ZnMnTe alloys. As expected, the photoluminescence peak energy decreased with increasing magnetic field. DOE

N93-22976# Oak Ridge National Lab., TN.
EPITAXIAL ZnS, ZnSe AND ZnS-ZnSe SUPERLATTICES GROWN ON (001)GaAs BY PULSED-LASER ABLATION
J. W. McCamy (Tennessee Univ., Knoxville.), D. H. Lowndes, J. D. Budai, G. E. Jellison, Jr., I. P. Herman, and S. Kim (Columbia Univ., New York, NY.) Nov. 1992 6 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005420; CONF-921101-37) Avail: CASI HC A02/MF A01

Pulsed KrF (248 nm) laser ablation of polycrystalline ZnS and ZnSe targets was used to grow high quality, fully epitaxial ZnS and ZnSe thin films on (001) GaAs. Photoluminescence measurements of the ZnS thin films show strong edge emission, while ZnSe thin films show free excitonic as well as donor and acceptor peaks. By alternately ablating each target, strained layer superlattices of the form (ZnSe)(m)-(ZnS)(n) were grown with as many as 65 periods of compositional modulation. A ZnS(x)Se(1-x) structure also was fabricated which simultaneously incorporated both continuously graded and abrupt compositional changes. DOE

N93-23022# Argonne National Lab., IL.
HIGH-TEMPERATURE Au IMPLANTATION INTO Ni-Be AND Ni-Si ALLOYS
M. R. James, N. Q. Lam, L. E. Rehn, P. M. Baldo, L. Funk, and J. F. Stubbins Dec. 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-005555; ANL/MSD/CP-76614; CONF-921101-40) Avail: CASI HC A02/MF A01

Effects of implantation temperature and target composition on depth distribution of implanted species were investigated. Au+ ions were implanted at 300 keV into polycrystalline Ni-Be and Ni-Si alloys between 25 and 700C to a dose of 10(exp 16) cm(exp -2). Depth distributions of Au were analyzed with RBS using He+ at both 1.7 and 3.0 MeV, and those of the other alloying elements by SIMS. Theoretical modeling of compositional redistribution during implantation at elevated temperatures was also carried out with the aid of a comprehensive kinetic model. The analysis indicated that below approximately 250C, the primary controlling processes were preferential sputtering and displacement mixing, while between 250 and 600C radiation-induced segregation was dominant. Above 600C, thermal-diffusion effects were most important. Fitting of model calculations to experimental measurements provided values for various defect migration and formation parameters. DOE

N93-23037# Oak Ridge National Lab., TN.
FABRICATION AND PROPERTIES OF Si3N4 WITH RARE EARTH APATITE GRAIN BOUNDARY PHASES
T. N. Tiegs, S. D. Nunn, K. L. Ploetz, P. A. Menchoffer, and C. A. Walls 1992 7 p Presented at the Materials Research Society Symposium, Boston, MA, 2-6 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005752; CONF-921206-7) Avail: CASI HC A02/MF A01

The rare earth-oxide and nitride apatites were examined as grain boundary phases in silicon nitride to assess their potential for developing high toughness materials using gas-pressure-sintering. Densification was dependent on the quantity of additives used with high densities achieved at equivalent oxygen contents of approximately 8 percent. Fracture toughnesses (K(sub Ic)) up to 8-10 MPA sqr.m were obtained for some compositions. Ambient temperature flexural strengths were in the range of 400-720 MPa; however, the strengths at elevated temperatures (1200 C) were reduced from these values. DOE

N93-23052# Ames Lab., IA.
SUPERCONDUCTIVITY AND FLUX PINNING IN Nd(1+x)Ba(2-x)Cu(3)O(7+DELTA)
S. I. Yoo, M. J. Kramer, and R. W. McCallum 24 Aug. 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-7405-eng-82)
(DE93-004444; IS-M-732; CONF-920802-42) Avail: CASI HC A01/MF A01

The substitution of Nd(+3) for Ba(+2) in Nd(1+x)Ba-(2-x)Cu(3)O(7+(delta)) (Nd123ss) increases the occupation of O(5) sites. For x greater than 0.1 there is a significant depression of T(sub c) and for x less than 0.1 there is no substantial decrease T(sub c) within experimental error. T(sub c) vs x is characterized by two plateaus analogous T(sub c) vs delta in YBa(2)Cu(3)O(7-delta)(Y123). Analysis of oxygen contents of Nd123ss suggests the analogy with Y123 is valid. The transition width and Meissner fraction for all Nd123ss samples are strongly dependent on the sintering temperatures. While T(sub c) is not affected over the range 0 is less than x is less than 0.1, the oxygens surrounding the substituted Ba sites are expected to locally suppress the superconducting order parameter. Hysteresis measurements exhibited a small increase in the magnetic J(sub c), but flux creep measurements showed no apparent effects of the substitution on the flux pinning energy. DOE

N93-23100 Minnesota Univ., Minneapolis.
MAGNETOTRANSPORT AND MAGNETOMETER STUDIES OF MAGNETIC THIN, SANDWICH AND MULTILAYER FILMS Ph.D. Thesis
Youjun Chen 1992 63 p
Avail: Univ. Microfilms Order No. DA9233975

Magnetotransport and magnetometer studies performed on single crystal thin Fe films grown on GaAs substrates by Molecular-Beam-Epitaxy method are described. In particular, the direct exchange interaction between the antiferromagnetic (AF) iron oxide on top of the Fe films and the underlying ferromagnetic (F) Fe is studied in detail. From the coupling strength, the iron oxide was identified as FeO. In addition to the epitaxial iron, an AF-F direct exchange interaction between Co and CoO was utilized to control the angle between the two Co layer magnetizations in Co/Cu/Co/CoO sputtered multilayer films. These samples were used to study the effect of antiparallel Co layer magnetizations on the anisotropic magnetoresistance (AMR). In addition to these samples, the effect of the antiparallel coupling between the Co layers on the AMR was also studied in Co/Cu coupled multilayer films. In both the few layers and multilayers, the phenomenon known as the giant magnetoresistance (GMR) was present. It is found that the GMR phenomenon has little effect on the AMR. This is apparently contrary to one class of the GMR models which utilizes the assumption of a near infinite spin flip scattering rate. An alternative two current explanation which doesn't require the near infinite spin flip scattering is presented.
Dissert. Abstr.

N93-23101 North Carolina Univ., Chapel Hill.
TRANSPORT IN AMORPHOUS SEMICONDUCTORS Ph.D. Thesis
Mathieu Kemp 1992 113 p
Avail: Univ. Microfilms Order No. DA9234982

Four problems of the physics of amorphous semiconductor are analyzed: (1) The potential fluctuations induced by a dilute density of charges are shown to produce exponential band tailing. The effect of screening is analyzed and shown to also produce exponential tailing. The logarithmic slope of the exponential tail is derived and shown to be a function of lattice spacing, permittivity and screening length, but to be charge density independent. This mechanism is suggested to be at the origin of the exponential tails observed in amorphous semiconductors. Experiments are suggested to test this. (2) A model coupling band conduction with hopping is used to compute the drift mobility. A low temperature transition from band conduction to hopping is predicted. In a DOE constant near the band edge and exponential below (cutoff DOS), the mobility either saturates or rises at the transition; with values appropriate to a-Si:H, the model predicts a mobility saturation rather than a rise. In an exponential DOS, the drift mobility does not show this behavior. Comparison with drift mobility measurements in a-Si:H suggests the cutoff DOS to be a more appropriate density of states than the exponential. Further experiments are suggested to test this. (3) The effect of the coulombic pair interaction on low temperature geminate recombination is shown to introduce two kinds of recombination dynamics depending on the width of the DOS. When the width is small, diffusion is anisotropically biased toward the hole; when the width is large, isotropy is recovered. (4) The assumption that low temperature geminate recombination is reaction limited is shown to breakdown when the localization length is small. The resulting diffusion limited process is shown to (1) induce two peaks in the lifetime distribution; and (2) to be sensitive to the DOS. The excitation density is shown to induce a transition to non-geminate recombination and a lifetime reduction. Comparison with a-Si:H data gives support to recombination being a diffusion limited process and to the DOS being non-exponential.
Dissert. Abstr.

N93-23197 Minnesota Univ., Minneapolis.
PHYSICAL PROPERTIES OF ULTRATHIN FILMS OF HIGH-TEMPERATURE SUPERCONDUCTORS Ph.D. Thesis
Tiefei Wang 1992 133 p
Avail: Univ. Microfilms Order No. DA9239163

Electrical transport measurements were carried out on ultrathin films of high temperature superconductor at extremely low temperatures and in high magnetic fields. These films were fabricated by molecular-beam-epitaxy (MBE). Normal state Hall effect measurements were carried out on both ultrathin and thin films. The Hall number (R(sub H)(exp -1)) was a linear function of temperature in thin films and was less temperature dependent in ultrathin films. The Hall angle (cot theta(sub H)) on the other hand exhibited the same T2 dependence in both cases, in accordance with Anderson's Luttinger liquid phenomenology. When the transition temperature decreased to zero the Hall number decreased to a limiting value which corresponded approximately to one pair per coherence volume. The superconductor-insulator transition was studied both in zero magnetic field and in a finite magnetic field. The zero field transition was achieved either by considering a sequence of films of decreasing thicknesses, or by successive thermal cycling of a single film in vacuum. The critical resistance was found to be very close to universal constant h/4e(exp 2) (6.5 k-omega). This result supports the notion that the critical resistance in the superconductor-insulator transition in two dimensions is universal. Anomalous magnetoresistance was observed in films having resistances with values near that of zero-field superconductor-insulator transition. This unusual behavior may result from an interaction between carriers and antiferromagnetically ordered Cu2+ spins of the CuO2 planes. Upon application of a magnetic field three successive superconductor-insulator transitions were found. The first two at low critical fields appear to result from the film sheet resistance being modulated by the applied magnetic field, possibly by scattering of the carriers from reorienting spins. The third one may represent the new type of superconductor-insulator transition proposed by Fisher, in which a film goes from a vortex glass to an electron glass with increasing magnetic field. All three transitions could be scaled. Evidences for magnetic-field-enhanced superconductivity in ultrathin high-T(sub c) films are presented. The phenomena are interpreted as being due to a combination of film's reduced dimensionality and the anomalous magnetoresistance.
Dissert. Abstr.

N93-23312# Oak Ridge National Lab., TN.
TIME-RESOLVED REFLECTIVITY STUDY OF SOLID-PHASE EPITAXIAL REGROWTH IN RELAXED AND STRAINED Si(1-x)Ge(x)
T. E. Hayes, C. Lee (Florida Univ., Gainesville.), and K. S. Jones (Florida Univ., Gainesville.) Nov. 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005154; CONF-921101-28) Avail: CASI HC A02/MF A01

The rate of solid-phase epitaxial regrowth was studied using time-resolved reflectivity in three different types of SiGe/Si epilayers amorphized by ion implantation. In two of these cases, the alloy epilayer contained either 12 percent or 20 percent Ge, and the amorphization depth was greater than the thickness (2000 A) of the SiGe alloy layer. Time-resolved reflectivity measurements showed that the rate of regrowth was not constant in these two cases, but first decreased after passing the SiGe/Si interface, and then increased. The minimum regrowth rate occurred closer to the SiGe/Si interface in the epilayers with the larger Ge atomic fraction. In the third type of sample, the alloy epilayer thickness was approximately 7 microns so that the initial epilayer (15 percent Ge) had the lattice constant of the bulk alloy. Furthermore, amorphization and regrowth occurred entirely within the relaxed alloy layer. In this case, the regrowth rate was constant. The composition dependence of the regrowth-rate transient in the strained layers is discussed in the context of a 'critical-thickness' model of strain relaxation.
DOE

N93-23314# Los Alamos National Lab., NM.
NOVEL MATERIALS SYNTHESIS USING AN INTENSE PULSED ION BEAM
D. C. Gautier, R. E. Muenchausen, D. J. Rej, B. F. Roberts, W. J. Waganarr, and G. Johnston (New Mexico Univ., Albuquerque.) 1992 8 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-7405-eng-36)
(DE93-005470; LA-UR-92-4322; CONF-921101-54) Avail: CASI HC A02/MF A01

Initial experiments on evaporation from metallic and ceramic targets using a pulsed light ion beam source is reported. The source is an intense ion beam produced by a 1.2 MV, 300 kJ Anaconda generator fitted with an extraction diode. Beam fluences of 10-20 J/sq cm gives a deposition rate of about 30-50 nm per shot, for both brass and YBa2Cu3O(7-x) (1-2-3) targets. This is about 1000 times greater than comparable rates from pulsed laser deposition (PLD). Single-shot ablated 1-2-3 films, deposited on Si, were analyzed using RBS; the measured stoichiometry was close to 1-2-3 in favorable cases, but shot-to-shot reproducibility was poor. Approximately 1 percent of the available ion beam energy was utilized for these initial experiments. The potential for producing large area coatings from multi-cation targets and nanophase powders using pulsed ion beam deposition will be discussed.
DOE

N93-23326# Sandia National Labs., Albuquerque, NM.
ENHANCED VORTEX PINNING AND CRITICAL CURRENT DENSITY IN PROTON-IRRADIATED YBa2Cu3O(7-DELTA) THIN FILMS
E. L. Venturini, M. P. Siegal, A. E. White, S. Y. Hou, and J. M. Phillips 1992 6 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005367; SAND-92-1668C; CONF-921101-25) Avail: CASI HC A02/MF A01

The appropriate fluence of 2.0 MeV H(sup +) ions has been shown previously to enhance the critical current density J(sub c) by a factor of two at a magnetic field of 0.9 tes!a in 1000 (Angstrom) thick epitaxial films of YBa(2)Cu(3)O(7-delta) grown by the ex situ BaF2 process. The as-grown films exhibit single crystal-like behavior in both atomic ordering and J(sub c) versus temperature and magnetic field. TRIM simulations suggest that H(sup +) irradiation generates mainly point defects throughout the crystal structure. We show here that such defects produce both a large enhancement of J(sub c) for fields above 1 tesla and a significant increase in the apparent vortex pinning potential deduced from magnetization relaxation data. DOE

N93-23329# Brookhaven National Lab., Upton, NY.
A THEORETICAL ANALYSIS OF THE EFFECT OF UNIAXIAL ELASTIC STRAIN ON THE CRITICAL TEMPERATURE OF CUPRATE SUPERCONDUCTORS
D. O. Welch and R. C. Baetzold (Eastman Kodak Co., Rochester, NY.) 1992 4 p Presented at the 5th United States/Japan Workshop on High Tc Superconductors, Tsukuba, Japan, 9-10 Nov. 1992
(Contract DE-AC02-76CH-00016)
(DE93-005710; BNL-48200; CONF-9211144-3) Avail: CASI HC A01/MF A01

Factors which influence the effect of uniaxial stress and strain on the superconducting critical temperature are discussed, with emphasis on the effect of uniaxial strain on the mobile hole density of YBa(2)Ci(3)O(7). DOE

N93-23393 Alabama Univ., Birmingham.
AN INVESTIGATION OF PROTEIN CRYSTAL GROWTH BY LASER LIGHT SCATTERING Ph.D. Thesis
John Bradford Bishop 1992 179 p
Avail: Univ. Microfilms Order No. DA9234723

Laser light scattering is utilized here to unobtrusively probe the sub-microscopic, macromolecular events within solutions from which protein crystals grow. Lysozyme and protamine insulin were studied. In this study the formation of a precrystalline aggregate is distinguished from that of an amorphous precipitant by photon correlation spectroscopy and by classical absolute scattering intensity measurements. A slight decrease in diffusion and a slight increase in intensity are shown to mark isothermal lysozyme nucleation. Light scattering is not typically done on supersaturated solutions, so before drawing conclusions, photon correlation with multiple scattering vectors (multi-q) was used to investigate interparticle interactions within 'monomeric' lysozyme solutions. The concentrations and temperature dependence of the effective hydrodynamic diameter of monomeric lysozyme were determined. In the supersaturated solutions the effective hydrodynamic diameter of the quasiequilibrium state is seen to vary with the degree of supersaturation. In the momomeric solutions the influence of hydrodynamic interactions is shown to predominate that of the thermodynamic interactions. It is concluded, that, although interparticle interactions affect the measurement of the effective diameter, small order aggregates are forming within the scattering volume during nucleation. Qualitative size distributions are presented, and scattering parameters for monitoring dynamically controlled lysozyme nucleation are offered. Dissert. Abstr.

N93-23395 Maryland Univ., College Park.
QUANTUM MONTE CARLO SIMULATION ON HUBBARD MODEL FOR HIGH TEMPERATURE SUPERCONDUCTIVITY Ph.D. Thesis
Aniket Bhattacharya 1992 177 p
Avail: Univ. Microfilms Order No. DA9234527

An extended Hubbard model on a copper-oxygen lattice in two dimension has gained considerable attention in the context of high temperature superconductivity. In this dissertation various properties of this model Hamiltonian have been explored using both the finite temperature path integral Monte Carlo and the Gutzwiller Variational Monte Carlo methods. Antiferromagnetism appears to occur at half-filling when oxygen-p level and copper-d level have substantial different energies. The dependence of the variational parameters on the Hamiltonian parameters are discussed. It is also shown that a simplified model keeping only the Coulomb correlation on the copper sites retains antiferromagnetism at half-filling with correct local moment and distribution of holes on copper and oxygen sites. The simulations for a small cluster indicate the possibility of extended s-wave and d-wave pairing in the extended Hubbard model. Motivated by the earlier work on flux-phases as possible ground states for the t-J model, which can be derived as a large-U limit of a single band Hubbard model, these flux phase states are studied for a single band Hubbard model using Gutzwiller's variational ansatz. Contrary to the previous results for the t-J model, the ground state of the Hubbard model is found to be always paramagnetic or antiferromagnetic. Near half-filling the t-J model with no double occupancy is dominated by magnetic energy, while Hubbard model with partial double occupancy is dominated by kinetic energy. When flux-phases are introduced into the Hubbard model, the decrease in magnetic energy is not enough to compensate the cost of kinetic energy increment. Dissert. Abstr.

N93-23397 Illinois Univ., Urbana-Champaign.
LOW-TEMPERATURE SPECIFIC HEAT OF SEVERAL HIGH-TEMPERATURE SUPERCONDUCTORS IN THE SUPERCONDUCTING AND MIXED STATES Ph.D. Thesis
Steven Elliot Stupp 1992 165 p
Avail: Univ. Microfilms Order No. DA9236601

The low-temperature specific heat of high quality, well characterized sintered polycrystalline samples of superconducting Ba(0.6)K(0.4)BiO(3), YBa(2)Cu(3)O(6.7), and Bi(2)Sr(2)CaCu(2)O(8+x) were measured in the superconducting state. Careful analysis of the data below 10 K indicate that the contribution to the specific heat which has a linear dependence on temperature, which has been observed in samples of YBa(2)Cu(3)O(7-delta), is not a universal feature of the high temperature superconductors. We observed that the linear term in YBa(2)Cu(3)O(7-delta) is weakly dependent on the oxygen content, delta. We argue that a linear term of 4 mJ/mole K2 is intrinsic to this compound, and while the origin of this linear term is still unknown it does not appear to be associated with the superconducting state. The low-temperature specific heat of the Bi(2)Sr(2)CaCu(2)O(8+x) samples were also measured in the mixed state in applied magnetic fields up to 3T. A strong field dependence in the specific heat was observed in the YBa(2)Cu(3)O(6.7) sample, while the specific heat of Bi(2)Sr(2)CaCu(2)O(8+x) was independent of field. The presence of a large field dependence at low-temperatures in the mixed state is not in agreement with the predictions of London theory. We mention several possible explanations for the large field dependence of the specific heat, including novel vortex structures, vortex kink nucleation, vortex core interactions, proximity effect coupling, and nodes in the superconducting gap. Dissert. Abstr.

N93-23468# Wright Lab., Wright-Patterson AFB, OH.
PROCESS TOWARD A COMPREHENSIVE CONTROL SYSTEM FOR MOLECULAR BEAM EPITAXY Interim Report, 1 Aug. 1990 - 30 Jul. 1992
Oliver D. Patterson, Jeffrey J. Heyob, Steven J. Adams, Victor Hunt, and Patrick H. Garrett Aug. 1992 19 p
(AD-A259724; WL-TR-92-4091) Avail: CASI HC A03/MF A01

A hierarchical control system for improving the manufacturing capability of the thin-film semiconductor growth process, Molecular Beam Epitaxy, is under development at the Air Force Materials Directorate. The focus of the first level is to improve the precision and tracking of the variables, flux, and substrate temperature. The second level consists of an expert system that uses sensors to monitor the status of the product in order to generate a process plan in real time. The third level features a continuously evolving neural network model of the process which is used to recommend the recipe and command inputs to achieve a desired product goal. All three levels require models of the process which are updated using automatic process identification experiments. The three levels of the system are described and experimental data is used to illustrate the impact of select modules. GRA

N93-23471# Morris Brown Coll., Atlanta, GA. Dept. of Chemistry.
MOLECULAR CONTROL OF LIQUID CRYSTALLINE ORIENTATION OF POLY (P-PHENYLENE -2,6-BENZOBISOXAZOLE) AND POLY (P-PHENYLENE -2,6-BENZOBISTHIAZOLE)
Issifu I. Harruna, Malcom B. Polk, B. Khamvongsa, A. Thuo, and J. Park 30 Nov. 1992 4 p
(Contract N00014-91-J-1643)
(AD-A259729) Avail: CASI HC A01/MF A01

The effect of molecular orientation on the transverse mechanical properties of poly(p-phenylene-2,6 benzobisoxazole) (PBO) and poly(2,5-benzoxazole) (ABPBO) were studied. ABPBO and PBO chains were prepared with radially shaped chain orientations with respect to the anthrone nucleus. The inherent viscosity of the ABPBO in methene-sulfonic acid at 20 C was 0.98 dL/g. The C-13 FT NMR spectrum of the star-like polymer showed a chemical shift at 75.0 ppm (relative to TMS) corresponding to the quaternary carbon in the 9-position of the anthrone ring. GRA

N93-23500 Oxford Univ. (England).
MACROSCOPIC MODELS OF SUPERCONDUCTIVITY Ph.D. Thesis
S. J. Chapman 1991 275 p
Avail: Univ. Microfilms Order No. BRD-97291

After giving a description of the basic physical phenomena to be modelled, we begin by formulating a sharp-interface free-boundary model for the destruction of superconductivity by an applied magnetic field, under isothermal and anisothermal conditions, which takes the form of a vectorial Stefan model similar to the classical scalar Stefan model of solid/liquid phase transitions and identical in certain two-dimensional situations. This model is found sometimes to have instabilities similar to those of the classical Stefan model. We then describe the Ginzburg-Landau theory of superconductivity, in which the sharp interface is 'smoothed out' by the introduction of an order parameter, representing the number of density of superconducting electrons. By performing a formal asymptotic analysis of this model as various parameters in it tend to zero we find that the leading order solution does indeed satisfy the vectorial Stefan model. However, at the next order we find the emergence of terms analogous to those of 'surface tension' and 'kinetic undercooling' in the scalar Stefan model. Moreover, the 'surface energy' of a normal/superconducting interface is found to take both positive and negative values, defining Type 1 and Type 2 superconductors respectively. We discuss the response of superconductors to external influences by considering the nucleation of superconductivity with decreasing magnetic field and with decreasing temperature respectively, and find there to be a pitchfork bifurcation to a superconducting state which is subcritical for Type 1 superconductors and supercritical for Type 2 superconductors. We also examine the effects of boundaries on the nucleation field, and describe in more detail the nature of the superconducting solution in Type 2 superconductors - the so-called 'mixed state'. Finally, we present some open questions concerning both the modelling and analysis of superconductors. Dissert. Abstr.

N93-23643# Aspen Center for Physics, CO.
SUMMARY OF THE 1992 ACP WINTER CONFERENCE ON FUTURE TRENDS IN LOW TEMPERATURE PHYSICS Final Report, 1 Dec. 1991 - 30 Nov. 1992
Michael Turner 6 Jan. 1993 8 p
(Contract N00014-92-J-1383)
(AD-A259809) Avail: CASI HC A02/MF A01

The following topics were a part of this conference: Boson Localization and the Onset of Superfluidity of 4He in Vycor; Critical Phenomena in the 4He-Aerogel System; Quantum Phase Transitions in Random Media; 3He on Surfaces; Laser Cooling and Manipulation of Neutral Particles; Pressing for Metallic Hydrogen: Experimental and Theoretical Challenges; Persistent Currents in Normal Metal Rings; Is the A Phase Really 'The A Phase'?; Electron Holography of Flux Lines; Phase Slips and Vortex Nucleation and Motion in Superfluid 4He Flow. GRA

N93-23673# Midwest Research Inst., Golden, CO.
GROWTH MECHANISMS AND CHARACTERIZATION OF HYDROGENATED AMORPHOUS-SILICON-ALLOY FILMS
A. Gallagher, R. Ostrom, D. Tanenbaum (National Inst. of Standards and Technology, Gaithersburg, MD.), and G. Stutzin Feb. 1993 17 p Prepared in cooperation with National Inst. of Standards and Technology, Gaithersburg, MD
(Contract DE-AC02-83CH-10093)
(DE93-000071; NREL/TP-411-5326) Avail: CASI HC A03/MF A01

This report describes an apparatus, constructed and tested, that allows measurement of the surface morphology of as-grown hydrogenated amorphous silicon films with atomic resolution using a scanning tunneling microscope. Surface topologies of 100-degree lambda-thick intrinsic films, deposited on atomically flat, crystalline Si and GaAs, are reported. These film surfaces are relatively flat on the atomic scale, indicating fairly homogeneous, compact initial film growth. The effect of probe-tip size on the observed topology and the development of atomically sharp probes is discussed. DOE

N93-23691# Ames Lab., IA.
A SOLID STATE APPROACH TO THE PRODUCTION OF KILOGRAM QUANTITIES OF Si80Ge20 THERMOELECTRIC ALLOYS
B. A. Cook, J. L. Harringa, and B. J. Beaudry 1992 8 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993
(Contract W-7405-eng-82)
(DE93-004476; IS-M-734; CONF-930103-28) Avail: CASI HC A02/MF A01

An important consideration in the development of improved materials for thermal-to-electrical power generation is whether a research-scale process or methodology is amenable to production of kilogram quantities. Research efforts on the solid state technique of mechanical alloying have shown that both n- and p-type Si-20 at. percent Ge alloys can be produced which have improved thermoelectric properties compared to state-of-the-art MOD-RTG materials. Studies on the production of large quantities of mechanically alloyed powder alloys using a planetary mill indicate that properties similar to those observed in alloys prepared in smaller quantities by a vibratory mill can be obtained. The characterization of several p-type alloys doped with 0.8 at. percent B in the form SiB4 by X-ray diffraction, scanning laser mass spectroscopy, Hall effect, and high temperature electrical resistivity and Seebeck coefficient measurements are described. The transport properties of these alloys are shown to be comparable to those measured on similar samples prepared in small quantities by a research-grade vibratory mill. DOE

N93-23727# Royal Military Coll. of Canada, Kingston (Ontario).
ACCURATE EVALUATION OF THE REAL AND IMAGINARY MATERIAL CONSTANTS FOR A PIEZOELECTRIC RESONATOR IN THE RADIAL MODE
S. Sherrit, N. Gauthier, H. D. Wiederick, and B. K. Mukherjee Jul. 1991 32 p
(Contract DREA-046)
(DREA-CR-91-451; CTN-93-60692) Avail: CASI HC A03/MF A01

The standard IEEE procedure for determining the piezoelectric, dielectric, and elastic constants associated with the radial mode resonance of piezoelectric materials neglects the imaginary components of these constants. A method is presented to determine the complex form of the above constants. These constants are calculated from the experimental values of the first and second series resonant frequencies, the first parallel resonance frequency and appropriate half band frequencies, and the low frequency admittance of the material, all of which can be measured on one disk sample. The method was also used to automate the current IEEE procedure for determining the real parts of the material constants. The method was applied to three test cases to test the limitations of the fit. The technique is limited at very high and low quality factors. The technique was also applied to a lead zirconate titanate sample, and the results and fit were found to be in excellent agreement. Author (CISTI)

N93-23950# Ames Lab., IA.
RECRYSTALLIZATION OF AMORPHOUS AND NANOCRYSTALLINE NdBa2Cu3O(7-x) AND GdBa2Cu3O(7-x)
T. J. Folkerts (Iowa State Univ. of Science and Technology, Ames.), K. W. Dennis, S. I. Yoo, and Y. Xu 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contracts W-7405-eng-82; DE-FG02-90ER-45427)
(DE93-004469; IS-M-722; CONF-920802-47) Avail: CASI HC A01/MF A01

Using a melt-spinning technique, both amorphous and nanocrystalline

NdBa2Cu3O(7-x) and GdBa2Cu3O(7-x) materials were produced. Samples melt-spun in O2 consist of nanocrystals with the tetragonal 123 structure while those processed in N2 show an amorphous matrix with small amounts of crystalline BaCu2O2, as shown by x ray diffraction (XRD) and transmission electron microscopy (TEM) studies. The difference is due to the strong dependence of the phase relations on the O2 partial pressure. Superconductivity can be fully restored by heating above 1000 C followed by a 450 C anneal in O2. High temperature XRD studies show that the 123 phase crystallizes directly from the amorphous matrix below 800 C. Poor superconducting properties for samples heated below 1000 C are attributed to disorders on the heavy metal sites. DOE

N93-23985 Alberta Univ., Calgary.
MAGNETIC ANISOTROPY IN THE HIGH TRANSITION TEMPERATURE SUPERCONDUCTOR YBa2Cu3O(7-DELTA) Ph.D. Thesis
Ado Umezawa 1991 214 p
Avail: Univ. Microfilms Order No. DANN70028

The strong anisotropy found in the electronic structure of YBa2Cu3O(7-delta) resulting from the existence of both the CuO2 planes within the a,b place and the CuO chains along the b axis has brought strong interest regarding the effect of the electronic structure anisotropy on the superconducting properties in this material. Such superconducting properties include both the intrinsic type (such as H(sub c1), H(sub c2), H(sub c), lambda, xi...) and the non-intrinsic type (such as flux pinning and j(sub c)). The availability of twinned and more recently, untwinned single crystals of YBa2Cu3O(7-delta) has made it possible for such anisotropic properties to be investigated. Magnetization critical current (j(sub c)) were measured for H//C and H//a,b in order to investigate the characteristics of flux pinning. The temperature dependence of j(sub c) was measured up to 77 K to determine the viability of the material for application use at such high temperatures. Irradiation of the single crystals with high energy neutrons is also done to investigate the possibility of using such a method for increasing j(sub c). Intrinsic superconducting parameters are investigated by measuring the magnitude and anisotropy of the lower critical field H(sub c1) and comparing it to the measurements of the upper critical field H(sub c2). From these values the magnitude and anisotropy of the other characteristic values such as lambda, kappa and H(sub c) are estimated using an anisotropic Ginzburg-Landau model. The temperature dependence of H(sub c1) was found to give unusual results, which differed with the direct temperature dependent measurements of the magnetic penetration depth lambda. The lower critical field was measured on an untwinned single crystal of YBa2Cu3O(7-delta) to investigate both the a-b anisotropy and the effects of the twin boundaries on the measurements of H(sub c1). Dissert. Abstr.

N93-24008# Oak Ridge National Lab., TN.
NEUTRON MEASUREMENTS OF THE VORTEX LATTICE IN YBa2Cu3O7
H. A. Mook, M. Yethiraj, G. D. Wignall, E. M. Forgan, S. L. Lee, R. Cubitt (Birmingham Univ., England.), D. McK. Paul (Warwick Univ., Coventry, England.), and T. Armstrong (Allied-Signal Corp., Torrance, CA.) 1992 22 p Presented at the Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005417; CONF-921201-13) Avail: CASI HC A03/MF A01

Neutron diffraction has been used to measure the vortex lattice scattering for YBa2Cu3O7. A square pattern is found when the field is applied along the c axis, while a triangular pattern is found when the field is applied well away from the c axis. High-resolution measurements for the square pattern show that the vortex lattice has long-range orientational order but only short-range positional order. The temperature dependence of the penetration depth is not that expected for a superconductor with a conventional s-wave BCS type gap. Preliminary measurements for temperatures near the irreversibility line are consistent with the occurrence of melting of the vortex lattice or glass phase. DOE

N93-24012# Sandia National Labs., Albuquerque, NM.
CAVITIES IN He-IMPLANTED Si: INTERNAL SURFACE SCIENCE
D. M. Follstaedt, S. M. Myers, and H. J. Stein 1992 7 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-005340; SAND-92-1367C; CONF-921101-64) Avail: CASI HC A02/MF A01

The concept of using internal cavities in semiconductors for surface studies is presented. The microstructures of He-implanted (001) Si are characterized with zone axes (110) cross-section TEM, which shows that internal areas 5-7 times that of the specimen front surface are achieved with 1 x 10(exp 17) He/sq cm implanted at 30 keV and annealed at 700 or 800 C. Examples using internal cavities to determine surface bond strengths of other elements adsorbed on Si are indicated. Facets on the cavities are used to examine the equilibrium crystal shape of Si and to measure the ratios of the surface free energies of the observed planes. The /111/ planes have the lowest energy, and those of /001/ and /110/ are 1.09(7) and 1.07(3) times higher, respectively. We also find cavities in He-implanted Ge after annealing that can be used for similar studies. DOE

N93-24017# Oak Ridge National Lab., TN.
SPECTROSCOPIC ELLIPSOMETRY AND INTERFERENCE REFLECTOMETRY MEASUREMENTS OF CVD SILICON GROWN ON OXIDIZED SILICON
G. E. Jellison, Jr., M. Keefer (Prometrix Corp., Santa Clara, CA.), and L. Thornquist (Prometrix Corp., Santa Clara, CA.) Nov. 1992 7 p Presented at the Materials Research Society Meeting, Pittsburgh, PA, 3 Nov. - 4 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-005767; CONF-9211127-2) Avail: CASI HC A02/MF A01

Several samples of thin-film silicon grown on oxidized Si, both oxidized and unoxidized, have been examined using spectroscopic ellipsometry (SE) and constunt angle reflection interference spectroscopy (CARIS). The SE data was fit to 5- or 6-layer models of the sample near surface region, using the optical functions of thin-film silicon determined from a previous work. Reasonable fits were obtained from samples containing amorphous Si(a-Si) or large-grain polycrystalline Si(p-Si), but fits to samples containing small-grain, undoped p-Si were poor unless a 8-15 nm surface roughness layer is included. Furthermore, the optical functions of p-Si:ud are not consistent from sample to sample. The optical functions determined from SE measurements were then used to interpret CARIS measurements, extracting the thicknesses of the films, which are then compared with the thicknesses obtained from SE. DOE

N93-24024# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
SOLID STATE RESEARCH Quarterly Technical Report, 1 Feb. - 30 Apr. 1992
Alan L. McWhorter 15 May 1992 77 p
(Contract F19628-90-C-0002)
(AD-A259726; Rept-1992; Rept-2; ESC-TR-92-129) Avail: CASI HC A05/MF A01

The research work of the Solid State Division at Lincoln Laboratory for the period 1 Feb. - 30 Apr. 1992 is covered. The topics covered are electrooptical devices, quantum electronics, materials research, submicrometer technology, high speed electronics, microelectronics, and analog device technology. Funding is provided primarily by the Air Force, with additional support provided by the Army, DARPA, Navy, SDIO, NASA, and DOE. GRA

N93-24034# Oak Ridge National Lab., TN.
SILICON NITRIDE CONTAINING RARE EARTH SILICATE INTERGRANULAR PHASES
S. D. Nunn, T. N. Tiegs, K. A. Ploetz, C. A. Walls, and N. Bell 1992 6 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-006624; CONF-921101-81) Avail: CASI HC A02/MF A01

Si3N4 ceramics prepared with refractory grain boundary phases to improve high temperature properties are difficult to density by conventional sintering methods. Gas-pressure sintering may be used to promote densification and development of acicular grains for improved fracture toughness. The current study examined rare earth silicate sintering aids with the composition M2Si2O7, where M is a trivalent cation (Y, La, Nd). M2O3 and SiO2 additions were varied to develop a number of compositions

in the Si3N4-Si2N2O-M2Si2O7 ternary phase field. Pressureless sintering and gas-pressure sintering were used to densify the samples. Densification, microstructure development, oxidation resistance, and mechanical properties were evaluated and compared with respect to compositional variations and processing conditions. DOE

N93-24040# North Carolina State Univ., Raleigh. Dept. of Materials Science and Engineering.
NITRIDE SEMICONDUCTORS FOR ULTRAVIOLET DETECTION Annual Report, 11 Mar. - 31 Dec. 1992
Robert F. Davis Dec. 1992 55 p
(Contract N00014-92-J-1720)
(AD-A259545) Avail: CASI HC A04/MF A01

Thin films of GaN and Al(x)Ga(1-x)N have been deposited by modified gas source MBE on alpha(6H)SiC(0001) and sapphire(0001). The values of x ranged from 0 to 1 in intervals of 0.2, as determined scanning Auger spectrometry. Simple UV photo detectors were produced and tested. The gains in the detectors was 10-20 at a bias voltage of 5 volts. The photocurrents for the solid solution detectors were much larger than for the pure GaN. Intrinsic, Mg p-type and Si n-type doped GaN films have also been achieved during growth. GaN thin films have also been achieved via atomic layer epitaxy on SiC substrates from triethy gallium and ammonia. Additional efforts have been channeled to develop luminescence facilities operative in the blue-UV wavelength range, ion implantation and contact studies and reactive ion etching facilities for GaN and AlN studies. GRA

N93-24050# California Univ., Berkeley. Lawrence Berkeley Lab.
GROWTH AND CHARACTERIZATION OF ISOTOPICALLY ENRICHED Ge-70 AND Ge-74 SINGLE CRYSTALS Ph.D. Thesis
K. Itoh Oct. 1992 78 p
(Contract DE-AC03-76SF-00098)
(DE93-004697; LBL-33028) Avail: CASI HC A05/MF A01

Isotopically enriched Ge-70 and Ge-74 single crystals were successfully grown by a newly developed vertical Bridgman method. The system allows us to reliably grow high purity Ge single crystals of approximately 1 cu cm volume. To our knowledge, we have grown the first Ge-70 single crystal. The electrically active chemical impurity concentration for both crystals was found to be approximately 2 x 10(exp 12) cm(exp -3) which is two orders of magnitude better than that of Ge-74 crystals previously grown by two different groups. Isotopic enrichment of the Ge-70 and the Ge-74 crystals is 96.3 percent and 96.8 percent, respectively. The residual chemical impurities present in both crystals were identified as phosphorus, copper, aluminum, and indium. A wide variety of experiments which take advantage of the isotopic purity of our crystals are discussed. DOE

N93-24083# Gordon Research Conferences, Inc., Kingston, RI.
REPORT OF THE GORDON RESEARCH CONFERENCE ON POINT DEFECTS, LINE DEFECTS, AND INTERFACES IN SEMICONDUCTORS Final Report
Patricia M. Mooney 3 Dec. 1992 10 p Conference held in Plymouth, NH, 20-24 Jul. 1992
(Contract N00014-92-J-1351)
(AD-A259546) Avail: CASI HC A02/MF A01

This report consists of the conference program, which includes 23 invited talks and 59 posters. No conference proceedings were published. GRA

N93-24101# Colorado State Univ., Fort Collins. Dept. of Physics.
HEXAGONAL FERRITES FOR MILLIMETER WAVE APPLICATIONS Final Report
Donald E. Polk and Kristl B. Hathaway 7 Jan. 1993 8 p
(Contract N00014-87-K-0325)
(AD-A260483) Avail: CASI HC A02/MF A01

A review of the work accomplished on this contract is presented. A review of the physics of hexagonal ferrite materials and the effective linewidth concept and the detailed overall research plan are contained in the original proposal document. The focus of the program was on the effective linewidth in millimeter wave materials, including planar hexagonal ferrite Y-type materials, uniaxial M-type materials, and thin ferromagnetic transition metal and alloy films. The key idea in the original proposal was that the ferromagnetic resonance (FMR) linewidth in hexagonal ferrites is dominated by inhomogeneous and two-magnon scattering losses and that off-resonance measurements of the effective linewidth would (1) show that the FMR losses do not represent the intrinsic losses, and (2) that the intrinsic losses are significantly lower. This basic idea was verified. Results were obtained on the off-resonance far-field effective linewidth in planar Zn-Y hexagonal ferrite single crystal platelets, single crystal spheres of Ba- and Sr-hexaferrite materials, and permalloy thin films. Three papers on these results were published. GRA

N93-24126# Ohio Univ., Athens. Dept. of Physics and Astronomy.
THE IN SITU OBSERVATION OF EPITAXIAL DIAMOND THIN FILM NUCLEATION AND GROWTH USING EMISSION ELECTRON MICROSCOPY Semiannual Report, 1 Apr. - 31 Dec. 1992
Martin E. Kordesch Dec. 1992 27 p
(Contract N00014-91-J-1596)
(AD-A259616) Avail: CASI HC A03/MF A01

A miniature gas dosing apparatus for low pressure (10(exp -4)) Torr diamond growth was tested: photoelectron microscope images were acquired under deposition conditions, and alteration in the image due to atomic hydrogen impact/reaction were observed. Diamond growth on polycrystalline films was not verified since incremental growth at the low rate expected will be difficult to detect on a rough substrate. Growth test on Mo(100) and (310) are underway. In situ etching of diamond in oxygen showned that diamonds are embedded in a Mo-carbide layer which remains after etching. The pits left after etching indicate nucleation on Mo, not Mo-carbide. The observation of ordered carbon films deposition from a methane/atomic hydrogen gas stream directed at a Mo(100) single crystal surface in situ at 1000 K continues. Attempts at creating nucleation sites to specifically enhance two dimensional growth were partially successful. For epitaxial systems, the LEED microscope, which uses diffraction contrast to form an image, will be used to study in situ steps and ledges engineered to match the diamond lattice. Diamond (100) LEED patterns and H2 desorption were observed. Si(310) wafers, Mo(310), and C(310) are currently being characterized. GRA

N93-24127# Research Triangle Inst., Research Triangle Park, NC.
HETEROEPITAXIAL DIAMOND GROWTH Annual Report, 16 Apr. - 31 Dec. 1992
Ronald A. Rudder, R. J. Markunas, J. B. Posthill, R. E. Thomas, and G. C. Hudson 12 Jan. 1993 104 p
(Contract N00014-92-C-0081)
(AD-A259623) Avail: CASI HC A06/MF A02

Progress continued in 1992 in the two major areas of the diamond program; diamond consolidation, and heteroepitaxial nucleation. A consolidation technology is being developed as one approach to large area diamond single crystals. During this phase of the program, techniques were developed for (1) bonding of natural diamond seed crystals to non-diamond substrates; (2) overgrowth for consolidation; and (3) ion-implantation for lift-off of thin diamond platelets. Experimental and theoretical progress was also made on heteroepitaxial growth of diamond. Theoretical modeling indicated a possible role of subsurface carbon in Ni(111) in preventing diamond nucleation. Experimental studies provided evidence for several roles for oxygen on diamond surfaces during diamond growth. Progress was also made in developing techniques for microstructural characterization of chemical vapor deposition (CVD) diamond. Transmission electron microscopy (TEM) sample preparation methods were developed for cross-sectional and plan-view analysis of diamond films and substrates. A simple method for rapidly assessing defect densities in CVD and natural diamond was also developed. GRA

N93-24134# Southern Methodist Univ., Dallas, TX.
MILLIMETER-WAVE APPLICATIONS OF SEMICONDUCTOR DIELECTRIC WAVEGUIDES WITH PLASMA LAYERS (SURFACE OR BURIED) GENERATED FROM SEMICONDUCTOR LASERS Final Report, Dec. 1988 - Sep. 1992
Jerome K. Butler Sep. 1992 73 p
(Contract DAAL03-89-K-0029)
(AD-A260484; ARO-25339.5-EL) Avail: CASI HC A04/MF A01

This research program was aimed at the theoretical and experimental investigations of semiconductor devices and waveguides with applications in millimeter wave systems. The major components considered included waveguide phase shifters, attenuators, and periodic structures designed to operate at the Second Bragg frequency. Most of the effort was directed at

theoretical and experimental understanding of the second-order Bragg structures since these components produce the most efficient radiating antennas. With a goal of locking several independent oscillators through gratings in the dielectric waveguide, the grating plays one of the most important roles in the system integration. Accordingly, two comprehensive computer models of dielectric gratings were developed and experimental measurements were made on more than fifty waveguide structures. GRA

N93-24146*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences and Center for Space Structures and Controls.

COUPLED STRUCTURAL, THERMAL, PHASE-CHANGE AND ELECTROMAGNETIC ANALYSIS FOR SUPERCONDUCTORS, VOLUME 1 Final Report, Sep. 1988 - Mar. 1993

Carlos A. Felippa, Charbel Farhat, K. C. Park, Carmelo Militello, and James J. Schuler Mar. 1993 317 p

(Grant NAG3-934)

(NASA-CR-192697; NAS 1.26:192697; CU-CSSC-93-06-1) Avail: CASI HC A14/MF A03

This research program has dealt with the theoretical development and computer implementation of reliable and efficient methods for the analysis of coupled mechanical problems that involve the interaction of mechanical, thermal, phase-change and electromagnetic subproblems. The focus application has been the modeling of superconductivity and associated quantum-state phase-change phenomena. In support of this objective the work has addressed the following issues: (1) development of variational principles for finite elements; (2) finite element modeling of the electromagnetic problem; (3) coupling of thermal and mechanical effects; and (4) computer implementation and solution of the superconductivity transition problem. The research was carried out over the period September 1988 through March 1993. The main accomplishments have been: (1) the development of the theory of parametrized and gauged variational principles; (2) the application of those principled to the construction of electromagnetic, thermal and mechanical finite elements; and (3) the coupling of electromagnetic finite elements with thermal and superconducting effects; and (4) the first detailed finite element simulations of bulk superconductors, in particular the Meissner effect and the nature of the normal conducting boundary layer. The grant has fully supported the thesis work of one doctoral student (James Schuler, who started on January 1989 and completed on January 1993), and partly supported another thesis (Carmelo Militello, who started graduate work on January 1988 completing on August 1991). Twenty-three publications have acknowledged full or part support from this grant, with 16 having appeared in archival journals and 3 in edited books or proceedings. Author

N93-24147*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences and Center for Space Structures and Controls.

COUPLED STRUCTURAL, THERMAL, PHASE-CHANGE AND ELECTROMAGNETIC ANALYSIS FOR SUPERCONDUCTORS, VOLUME 2

Carlos A. Felippa, Charbel Farhat, K. C. Park, Carmelo Militello, and James J. Schuler Mar. 1993 291 p

(Grant NAG3-934)

(NASA-CR-192698; NAS 1.26:192698; CU-CSSC-93-06-2) Avail: CASI HC A13/MF A03

Two families of parametrized mixed variational principles for linear electromagnetodynamics are constructed. The first family is applicable when the current density distribution is known a priori. Its six independent fields are magnetic intensity and flux density, magnetic potential, electric intensity and flux density and electric potential. Through appropriate specialization of parameters the first principle reduces to more conventional principles proposed in the literature. The second family is appropriate when the current density distribution and a conjugate Lagrange multiplier field are adjoined, giving a total of eight independently varied fields. In this case it is shown that a conventional variational principle exists only in the time-independent (static) case. Several static functionals with reduced number of varied fields are presented. The application of one of these principles to construct finite elements with current prediction capabilities is illustrated with a numerical example. Author

N93-24167# University of Southern California, Los Angeles. Dept. of Materials Science and Engineering.

OPTICAL STUDIES OF LATERALLY CONFINED QUANTUM WELL STRUCTURES GROWN ON EX-SITU AND IN-SITU PATTERNED SUBSTRATES Final Technical Report, 18 Sep. 1989 - 17 Sep. 1992

Anupam Madhukar 29 Dec. 1992 31 p

(Contract DAAL03-89-K-0170)

(AD-A260275; ARO-27298.1-EL) Avail: CASI HC A03/MF A01

The issues examined are summarized and the findings are related to (1) absorption and electroabsorption behavior of strained GaAs/InGaAs multiple quantum wells (MQW), (2) the dc transport characteristics of strained GaAs/InGaAs/AlAs based resonant tunnelling diodes, and (3) realization of three-dimensionally confined quantum well structures on patterned GaAs(111)B substrates via a one-step growth process labelled substrate encoded sized reducing epitaxy (SESRE). Use of pre-patterned substrates as a means of strain relief without the generation of dislocations is shown to allow growth of high quality MQW's to thicknesses of approximately 1 micron needed for sufficient optical interaction path length in p-i(MQW)-n modulators and detectors. The role of defect induced deep levels in impacting the exciton linewidth through their influence on the internal field distribution is revealed for the first time. Three dimensionally confined GaAs/AlGaAs structures are realized for the first time using SESRE. GRA

N93-24194# Illinois Univ., Chicago. Dept. of Physics.

INFLUENCE OF DEFECTS IN HgCdTe GROWN BY MOLECULAR BEAM EPITAXY (MBE) ON ELECTRICAL DEVICES Final Report, 1 Jun. 1987 - 31 Dec. 1990

Jean-Pierre Faurie 30 Nov. 1992 23 p

(Contract DAAL03-87-K-0092)

(AD-A260457; ARO-25133.1-PH) Avail: CASI HC A03/MF A01

In this program, the Microphysics Laboratory has been successful in: (1) identifying the presence of microtwins in HgCdTe(111)B grown by MBE which are limiting device performance and yield; (2) determining their relation with the structural and electrical properties of the epilayer; (3) understanding their formation mechanism; (4) controlling and eliminating their formation through stringent control of the growth parameters; and (5) in formulating the hypothesis that impurities, very likely diffusing from the substrate, are present in the epilayer. GRA

N93-24195 California Univ., San Diego.

STUDY OF THE MODEL OF HOLE SUPERCONDUCTIVITY IN MULTIPLE BAND CASES AND ITS APPLICATION TO TRANSITION METALS Ph.D. Thesis

Xue Qi Hong 1992 137 p

Avail: Univ. Microfilms Order No. DA9227863

We began our investigation by studying a simple model consisting of a chain of atoms with two atoms per unit cell. This model develops two bands when the inter-cell and intra-cell hopping amplitudes are different. We have found that superconductivity predominantly occurs when the Fermi level is close to the top of the upper band where the wavefunction has antibonding feature both inside the unit cell and between unit cells. Superconductivity occurs only in a restricted parameter range when the Fermi level is close to the top of the lower band because of the repulsive interaction within the unit cell. We find that pair expectation values that 'mix' carriers of both bands can exist when interband interactions other than V12 of Suhl et al are present. But the magnitude of the 'mixed pairs' order parameters is much smaller than that of the intra-band pairs. The V12 of Suhl et al is the most important interband interaction that gives rise to the main features of a two-band model: a single transition temperature and two different gaps. We have used the model of hole superconductivity to study the variation of T(sub c) among transition metal series--the Matthias rules. We have found that the observed T(sub c)'s are consistent with superconductivity of a metal with multiple bands at the Fermi level being caused by the single band with strongest antibonding character at the Fermi level. When the Fermi level is the lower part of a band, there is no T(sub c). As the band is gradually filled, T(sub c) rises, passes through a maximum, then drops to zero when the band is full. This characteristic feature is independent of any fine structure of the band. The position of the peak and the width of the peak are correlated. Quantitative agreement with the experimental results is obtained by choosing parameters of onsite Coulomb interaction U, modulated hopping term Delta-t, and nearest neighbor

repulsion V to fit the magnitude of T(sub c) and the positions of experimental peaks. Rigid band approximation is used for regions of different crystal structure. Dissert. Abstr.

N93-24199# Advanced Technology Materials, Inc., Danbury, CT.
GAS SOURCE MOLECULAR BEAM EPITAXIAL GROWTH OF GaN Final Report, 1 Aug. 1989 - 15 Sep. 1990
Duncan W. Brown 25 Nov. 1992 34 p
(Contract DAAL03-89-C-0023)
(AD-A260524; ARO-27320.1-EL-SBI) Avail: CASI HC A03/MF A01

Aluminum gallium nitride (AlGaN) has long been recognized as a promising radiation hard optoelectronic material. AlGaN has a wide direct band gap and therefore has potential applications in the fabrication of short wave-length devices, e.g., detectors and light-emitting diodes in the visible to ultraviolet region. Additionally, its piezoelectric properties and high acoustic velocities make it attractive for acoustic devices. The technical objective in Phase 1 was to determine if low temperature sources based on covalently bonded Group 3-nitrogen compounds could be used to prepare AlGaN films by gas source molecular beam epitaxy. The program required to investigate low temperature AlGaN source materials was separated into two parts: (1) the synthesis, purification, and pyrolysis of gallium-nitrogen adducts and aluminum-nitrogen adducts; and (2) the growth of GaN by chemical beam epitaxy. We clearly demonstrated under CBE conditions GaN(x)C(y) films could be grown using compounds with pre-existing Ga-N bonds whereas no films were formed using trimethylgallium. Dimethylgallium amide was shown to produce dramatically lower carbon content films in the presence of ammonia than did trimethylgallium in the presence of ammonia. GRA

N93-24216 Boston Univ., MA.
HETEROEPITAXIAL GROWTH OF GALLIUM NITRIDE AND NATIVE DEFECT FORMATION IN III-V NITRIDES Ph.D. Thesis
Ting Lei 1993 149 p
Avail: Univ. Microfilms Order No. DA9233214

ECR-MBE was developed as a new method for the growth of GaN films. In this method, the film growth proceeds by the reaction of Ga vapor with ECR-activated molecular nitrogen at relatively low temperatures, which allow the growth of stoichiometric GaN films. In addition, the ultrahigh vacuum environment reduces the incorporation of unwanted impurities. To control nucleation and initial growth, a new growth process has been developed, in which a GaN buffer layer is grown first at relatively low temperatures, where the growth is dominated by kinetics. The growth of the rest of the film proceeds at elevated temperatures, where the growth is dominated by thermodynamics. This deposition method was found to lead to a quasi-layer-by-layer growth with a lateral growth rate 100 times faster than the vertical one. The surface roughness of the film was found to be less than 100 A. Epitaxial single crystalline GaN films were grown for the first time in Si(001) and (111) substrates, using this two-step process. The GaN films on Si(001) are single crystalline, and epitaxially stabilized in the metastable zincblende structure. The GaN films on Si(111) were grown in the wurtzite structure, and were found to have a considerable number of stacking faults along the (0002) direction, which gives rise to a significant zincblende component with (111) orientation. Heteroepitaxial GaN films were also grown on more widely used a-plane and r-plane sapphire substrates using this two-step growth process. The structure, microstructure and epitaxial relationship to the substrate of GaN films were investigated by RHEED, X-ray diffraction and electron microscopy. Stacking faults have been identified for the first time as one of the dominant structural faults in GaN films with (0002) orientation. Electrical properties of GaN films were investigated and a new transport mechanism involving two conduction paths were proposed. Optical properties were studied by absorption measurement and cathodoluminescence. Ab-initio quantum total energy calculations were performed to study the formation of the native defects in GaN and BN. Preliminary results on the wurtzite GaN confirm that nitrogen vacancies are the dominant native point defects giving rise to n-type conductivity. Additionally, these calculations also predict defect induced stabilization of cubic BN over graphitic BN. Dissert. Abstr.

N93-24262# California Univ., Santa Barbara. Dept. of Physics.
QUANTUM MECHANICS OF ELECTRONS IN CRYSTALS WITH GRADED COMPOSITION
M. R. Geller and W. Kohn Mar. 1993 16 p
(Contract N00014-89-J-1530)
(AD-A260294; TR-43) Avail: CASI HC A03/MF A01

The effective Hamiltonian is constructed describing the motion of electrons in compositionally graded crystals which is valid throughout a given energy band and part way into the gaps. The effective Hamiltonian, constructed from the band structures of uniform crystals, also includes the effects of a slowly varying applied scalar potential U(r). Near the edges of a nondegenerate band, this effective Hamiltonian reduces to an effective mass Hamiltonian with position dependent mass (one of several forms previously appearing in the literature): H(sub eff) = 1/2 p(sub i)((1/m*r)(sub ij))p(sub j) + epsilon(r) + U(r), where epsilon(r) is the energy of the band edge as a function of position. The analogous effective mass Hamiltonian for degenerate bands is also derived. Next, more general states-not restricted to the vicinity of a band edge in crystals with composition and applied potential variation in one direction are examined. A Wentzel-Kramer-Brillouin (WKB)-type solution for the envelope functions, as well as the appropriate turning point connection rules is obtained. GRA

N93-24281# Pennsylvania State Univ., University Park. Materials Research Lab.
DIAMOND HOMOEPITAXY BY CHEMICAL VAPOR DEPOSITION Annual Report, 1 Jan. - 31 Dec. 1992
Andrzej Badzian and Teresa Badzian Feb. 1993 13 p
(Contract N00014-92-J-1421)
(AD-A260551) Avail: CASI HC A03/MF A01

Gem-quality single crystals of diamond were grown by homoepitaxy using microwave plasma assisted chemical vapor deposition. Raman spectra of the (001) film show very low background and the narrowest width at half maximum of the 1332 /cm peak was 1.7 /cm. A prism crystal 1.2 mm high was grown in the group of zone axes (110) direction at 1200 C and 1 percent CH4 in H2. Its Raman peak has a width of 2.7 /cm. Homoepitaxy is a tool used to study growth processes by analyzing the geometrical details of surfaces morphologies. Growth steps on the (001) surface develop in the group of zone axes (110) directions while triangular plates appear on the (111) surface. The (110) atomic plane does not appear in the group of zone axes (110) growth direction with microfaceted (111) and (111) planes present instead. Crystal structure of diamond grown in the (001), (111), (110) substrates, as well as growth sectors developed in conjunction with this epitaxy, were studied by X-ray diffraction techniques: Laue, oscillation and rotation methods. Atomic force microscopy teached atomic resolution on the (001) surface. The presence of a 2.12 A reflection demonstrated distortion of cubic symmetry and deformation of carbon tetrahedra in the case of (111) epitaxy. In the (110) growth sector a polytype/superstructure network with periodicity three times larger than that of the cubic form was determined. In general it is possible to form tetrahedral carbons with the sequence of tetrahedra different from that of cubic and hexagonal diamonds. GRA

N93-24292 Hull Univ. (England).
ASPECTS OF SINGLE CRYSTAL AND THIN FILM HIGH FIELD ELECTROLUMINESCENCE Ph.D. Thesis
Michael Joseph Rober Swift 1989 319 p
Avail: Univ. Microfilms Order No. BRDX97596

Electro-optical investigations of unimplanted and ion implanted ZnS and ZnSe direct current electroluminescent (DCEL) devices under reverse bias have enabled advances to be made in understanding some of the physical processes which govern the behavior of such devices. The three types of devices studied were ZnS thin films, ZnS single crystal diodes and ZnSe single crystal diodes. For reasons discussed in the text, greatest stability and uniformity in electroluminescence characteristics were achieved using ion implanted ZnSe single crystals and experiments were predominantly based on such devices. A complicated, but effective, fabrication procedure which involved a multilayer contact structure enabled stable current-voltage characteristics and uniform electroluminescence to be obtained from the ion implanted ZnSe diodes. From the current-voltage characteristics it is clear that the dominant mechanism responsible for the observed current in such devices is the tunnelling of electrons through the Schottky barrier. Analysis of the electroluminescence and cathodoluminescence of ZnSe and ZnS single crystal devices in which both manganese ions and erbium ions have been implanted in the same region and to the same concentration allowed relative cross-sections for impact excitation of the Mn(2+) ions

and Er(3+) ions to be calculated. From these calculations it was concluded that the exchange scattering mechanism is responsible for the excitation of Mn(2+) ions. From the applied voltage dependence of the spectral emission intensities of Er(3+) ion transitions in an implanted ZnSe:Er device, the electron energy distribution was shown to be of the Druyvesteyn type. Under certain simplifying assumptions, such an energy distribution can be derived theoretically from the Boltzmann transport equation. Combining theory with experiment shows that the scattering centres which are responsible for the production of a Druyvesteyn distribution have very large impact cross-sections. It is thus concluded that complex molecules, probably involving Er(3+) ions and native lattice defects, are present in these devices. Dissert. Abstr.

N93-24425# California Inst. of Tech., Pasadena.
RESEARCH IN PHOTOREFRACTIVE CRYSTALS Final Report, 15 Sep. 1989 - 14 Sep 1992
R. Hofmeister, A. Kewitsch, A. Agranat, and A. Yariv 6 Jan. 1993 80 p
(Contract DAAL03-89-K-0153)
(AD-A260391; ARO-27273-14-PH) Avail: CASI HC A05/MF A01

Research in photorefractive materials in the last three years has involved the development of crystal growth techniques as well as characterization and application of the grown materials. Potassium tantalate niobate (KTN) and potassium lithium tantalate niobate (KLTN) were grown. GRA

N93-24433# Midwest Research Inst., Golden, CO.
RESEARCH ON HIGH EFFICIENCY, LARGE-AREA CuInSe2-BASED THIN-FILM MODULES
K. W. Mitchell and C. Eberspacher Feb. 1993 57 p Prepared in cooperation with Siemens Solar Industries, Camarillo, CA
(Contract DE-AC02-83CH-10093)
(DE93-000077; NREL/TP-413-5332) Avail: CASI HC A04/MF A01

The objective was to demonstrate 12.5 percent aperture efficient, large area (3900 cm(sup 2)) encapsulated thin thin CuInSe2 (CIS) modules. The module design consists of 53 series-connected ZnO/CdS/CIS/Mo/glass cells fabricated on a glass substrate. A baseline characterization of the CIS modules was established during Phase 1. Maps of open circuit voltage provide information on junction quality uniformity. Maps of cell voltages at fixed forward bias show variations in resistance losses due to interconnects. Individual cell I-V curves can be evaluated. Physical nature of defects is correlated using OBIC, EBIC, SEM, tape adhesion, etc. A new world record of 37.7 W and 9.7 percent aperture efficiency was attained for an encapsulated module; an unencapsulated CIS module plate achieved 40.8 W and 10.5 percent aperture efficiency. DOE

N93-24462# Ames Lab., IA.
HIGH TEMPERATURE RARE EARTH AND Si-Ge THERMOELECTRIC MATERIALS Ph.D. Thesis
Sang Hyun Han 21 Jan. 1993 155 p
(Contract W-7405-eng-82)
(DE93-006913; IS-T-1636) Avail: CASI HC A08/MF A02

This thesis consists of three papers. Paper 1 is concerned with the preparation of metastable crystalline high temperature polymorph of Dy2S3 or metastable crystalline high pressure polymorphs of R2S3 (R = Y, Er, Tm, Yb and Lu) by mechanical milling. In Paper 2, copper doped dysprosium sesquisulfide compounds, which have the (eta)-orthorhombic structure, were examined as potential high temperature thermoelectric materials. Paper 3 deals with the use of mechanical alloying and gaseous state diffusion to extend the electrical activity of phosphorus above the maximum reported equilibrium limit in Si(80)Ge(20) alloys. DOE

N93-24483*# Clemson Univ., SC. Dept. of Ceramic Engineering.
SUPERCONDUCTIVITY DEVICES: COMMERCIAL USE OF SPACE Semiannual Report, 3 Jul. 1992 - 31 Mar. 1993
Gene Haertling, Eugene Furman, Chi-Shiung Hsi, and Guang Li 31 Mar. 1993 130 p
(Grant NAG1-1301)
(NASA-CR-192841; NAS 1.26:192841) Avail: CASI HC A07/MF A02

A YBCO thick film containing 20 percent Ag2O with a T(sub c) of 86.8 K and J(sub c) of 108 A/sq cm was obtained. The film was fabricated by a two-step firing process, i.e., firing the film at 1000 C for 10 minutes and annealing at 970 C for 30 minutes. The two-step firing process, however, was not suitable for the multiple-lead YBCO sample due to the formation of the 211 green phase at 1000 C in the multiple-lead YBCO sample. A BSCCO thick film printed on a MgO coated MSZ substrate and fired at 845 C for 2 hours exhibited a superconducting behavior at 89 K. Because of its porous microstructure, the critical current density of the BSCCO thick film was limited. This report also includes the results of the YBCO and BSCCO materials used as oxide electrodes for ferroelectric materials. The YBCO electroded PLZT showed higher remanent polarization and coercive field than the sample electroded with silver paste. A higher Curie temperature for the PLZT was obtained from the YBCO electroded sample. The BSCCO electroded sample, however, exhibited the same Curie temperature as that of a silver electroded sample. Dissipation factors of the ferroelectric samples increased when the oxide electrode was applied. Author (revised)

N93-24496# Los Alamos National Lab., NM.
COMPOSITIONAL SUPERLATTICES BASED ON PtCl/PtBr MX MATERIALS
A. Saxena, X. Z. Huang, and A. R. Bishop 1992 6 p Presented at the 1992 International Conference on Science and Technology of Synthetic Metals, Goeteborg, Sweden, 12-18 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003700; LA-UR-92-3249; CONF-9208132-8) Avail: CASI HC A02/MF A01

We consider theoretically a novel class of compositional superlattices consisting of alternating layers of quasi-one-dimensional (Q1D) MX (halogen-bridged, transition metal) chain materials. In particular, we have studied a superlattice based on the PtCl/PtBr unit where the Peierls band gap for PtCl is approximately 2.4 eV and approximately 1.5 eV for PtBr. We have calculated electronic properties, optical absorption, and vibrational properties (e.g., Raman spectrum) of an MX superlattice using a discrete, two-band, tight-binding Peierls-Hubbard model. The electronic band structure reveals a typical subband structure and varies with the relative lengths of the constituent PtCl and PtBr units. The MX superlattice can be thought of as an analog of a GaAs/GaAl(x)As(1-x) compositional superlattice but with the added feature that the optical, transport, and various other physical properties are modified due to presence of nonlinear excitations (e.g., polarons) in the doped samples. DOE

N93-24511# Princeton Univ., NJ. Dept. of Chemistry.
ASPECTS OF PHOTOIONIZATION OF IMPURITIES AND ELECTRON TRANSFER IN IONIC CRYSTALS
D. S. McClure 10 Feb. 1993 10 p
(Contract DE-FG02-84ER-45146)
(DE93-008544; DOE/ER-45146/7) Avail: CASI HC A02/MF A01

Spectral evidence was found for photoionization in spectra of Eu(sup 2+) and Sm(sup 3+) in BaF2; Ce(sup 3+) was also studied in BaF2, CaF2, and SrF2. Two-photon spectroscopy of forbidden transitions (zero-phonon lines) was extended from NaF: Cu(sup +) to Mn(sup 4+) in Cs2GeF6 and to MgO:Ni(sup 2+). DOE

N93-24512# Argonne National Lab., IL.
STUDIES OF MICROSTRUCTURE/CRITICAL CURRENT DENSITY RELATIONSHIPS FOR GRAIN BOUNDARIES IN YBa2Cu3O(7-DELTA) BICRYSTALS
S. E. Babcock, Xue-Yu Cai, D. C. Larbalestier, D. H. Shin, Na Zhang (Wisconsin Univ., Madison.), Yufei Gao, K. L. Merkle, and D. L. Kaiser (National Inst. of Standards and Technology, Gaithersburg, MD.) 1992 5 p Presented at the 6th International Conference on Intergranular and Interphase Boundaries in Materials, Thessaloniki, Greece, 22-26 Jun. 1992
(Contract W-31-109-eng-38)
(DE93-003000; ANL/CP-77534; CONF-920670-6) Avail: CASI HC A01/MF A01

Results of coupled electromagnetic and microstructural studies of bicrystalline YBa2Cu3O(7-delta) specimens are described from a microstructural perspective. High-spatial-resolution transmission electron microscopy techniques (imaging and energy dispersive x-ray microanalysis) are used to probe the structure and composition of the grain boundaries. All of the boundaries studied possess microstructural features that are consistent with their specific electromagnetic character. DOE

N93-24518# Los Alamos National Lab., NM.
LOW-TEMPERATURE DEPOSITION OF ZrC THIN FILMS FROM A SINGLE SOURCE PRECURSOR
David C. Smith, Rodrigo R. Rubiano, Matthew D. Healy, and Robert W. Springer (Massachusetts Inst. of Tech., Cambridge.) 1992 9 p Presented at the 16th Material Research Society International Symposium on the Scientific Basis for Nuclear Waste Management Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-7405-eng-36)
(DE93-007333; LA-UR-93-351; CONF-921101-83) Avail: CASI HC A02/MF A01

Stable zirconium carbide thin films have been deposited from a single source organometallic precursor, tetraneopentyl zirconium, at substrate temperatures above 500C. Materials deposited above this temperature are crystalline by X-ray diffraction. A metal to carbon ratio of 1:2 is observed by Auger electron spectroscopy depth profiling. X-ray photoelectron spectroscopy indicates the zirconium is single phase. The observed spectra correspond well to spectra for zirconium carbide standards. Carbon XPS reveals carbidic and graphitic or hydrocarbon species with a third unknown carbon species. Elastic recoil detection finds a large, up to 16 percent hydrogen content in the thin film. DOE

N93-24647# National Inst. of Standards and Technology, Boulder, CO. Materials Reliability Div.
MODELING OF X-RAY DIFFRACTION LINE BROADENING WITH THE VOIGT FUNCTION: APPLICATIONS TO HIGH-T(c) SUPERCONDUCTORS Ph.D. Thesis
Davor Balzar (Zagreb Univ., Yugoslavia.) Jan. 1993 101 p
(PB93-152072; NISTIR-3398) Avail: CASI HC A06/MF A02

A method to analyze powder-diffraction line broadening is proposed and applied to some novel high-T(c) superconductors. Assuming that both size-broadened and strain-broadened profiles of the pure-specimen profile are described with a Voigt function, it is shown that the analysis of Fourier coefficients leads to the Warren-Averbach method of separation of size and strain contributions. The method was applied to two cubic structures with average volume-weighted domain sizes up to 3600 A, as well as to tetragonal and orthorhombic (La-Sr)2CuO4, which exhibit weak line broadenings and highly overlapping reflections. Comparison with the integral-breadth methods is given. Reliability of the method is discussed in the case of a cluster of the overlapping peaks. The analysis of La2CuO4 and La(1.85)M(0.15)CuO4 (M = Ca, Ba, Sr) high-T(c) superconductors showed that microstrains and incoherently diffracting domain sizes are highly anisotropic. In the superconductors, stacking-fault probability increases with increasing T(c); microstrain decreases. In La2CuO4, different broadening of (h00) and (0k0) reflections is not caused by stacking faults; it might arise from lower crystallographic symmetry. GRA

N93-22194*# Laboratory for Physical Sciences, College Park, MD.
TUNNELING MAGNETIC FORCE MICROSCOPY
Edward R. Burke, Romel D. Gomez (Maryland Univ., College Park.), Amr A. Adly (Maryland Univ., College Park.), and Isaak D. Mayergoyz (Maryland Univ., College Park.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 429-438 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22863# Institut de Mecanique des Fluides de Marseille (France).
HEAT TRANSFER SIMULATION WITH A CONDUCTIVE-RADIATIVE MODEL FOR PREDICTING THE SHAPE OF HgI2 CRYSTAL GROWN IN THE LTVG FURNACE
A. Roux and A. Fedoseyev (Academy of Sciences, USSR, Moscow.) *In* ESA, Fluids in Space Jun. 1992 p 547-552 (For primary document see N93-22830 08-29)
(Contract ESA-8431/89/F/BZ)
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24395# Genoa Univ. (Italy).
CONTROL OF THE CONCENTRATION GRADIENT DURING CRYSTAL GROWTH FROM SOLUTION
F. Bedarida, G. A. DallAglio, A. C. Hernandes (Sao Paulo Univ., Brazil.), E. Piano, and C. Pontiggia *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 331-334 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N93-22426# California Univ., Berkeley. Lawrence Berkeley Lab.
TOWARDS A FIRST-PRINCIPLES THERMODYNAMICS OF SOLIDS
D. deFontaine and C. Wolverton Aug. 1992 31 p Presented at the 91st Annual Conference of the Deutsche Bunsen-Gesellschaft Fuer Physikalische Chemie, Vienna, Austria, 28-30 May 1992
(Contract DE-AC03-76SF-00098)
(DE93-002544; LBL-32832; CONF-9205273-1) Avail: CASI HC A03/MF A01

Total energy density-functional methods have made it possible to calculate, from first principles, such important properties as cohesive energies, lattice constants, and elastic moduli for elemental crystals and perfectly ordered compounds. Real solids are imperfect, however, so that lattice vibrations and compositional disorder lead to entropy contributions, vibrational, and configurational. When these effects are included in an appropriate manner, properties of real crystals can be computed ab initio as a function of temperature and concentration. Consequently, it is possible to obtain, virtually from the knowledge of atomic numbers alone, such basic thermodynamic properties as free energies, entropies, heats of formation, and lattice parameters for stable and metastable phases, leading, for example, to the successful computation of certain classes of phase diagrams. Recent progress in the field will be reviewed. Application is made to the Pd-Rh-V system. DOE

N93-22732# Arizona Univ., Tucson. Optical Sciences Center.
QUANTUM THEORY OF MULTIWAVE MIXING WITH APPLICATIONS TO SQUEEZING IN BOTH ATOMIC AND SEMICONDUCTOR MEDIA Final Report
Murray Sargent, III 21 Dec. 1992 6 p
(Contract N00014-90-J-1029)
(AD-A259875) Avail: CASI HC A02/MF A01

The overall purpose of the contract was to investigate various aspects of the quantum theory of multiwave mixing with applications to squeezing in both atomic and semiconductor media. In the following seven sections, we related areas. We also list the corresponding papers presented at meetings, the papers published in journals, and the work completed on two books. The topics addressed are: (1) injected atomic coherence; (2) bichromatic and local-field-correction quantum multiwave mixing; (3) composite-cavity mode laser; (4) spectral hole burning and population pulsations in SCL gain media; (5) quantumm multiwace mixing in semiconductor laser media; (6) semiconductor laser photon statistics; and (7) semiconductor laser linewidth. CASI

N93-22753# Los Alamos National Lab., NM.
TOPOLOGICAL ORGANIZATION OF (LOW-DIMENSIONAL) CHAOS
N. B. Tufillaro 1992 6 p Presented at the NATO/ASI Summer School: From Statistical Physics to Statistical Inference and Back, Cargese, France, 31 Aug. - 12 Sep. 1992
(Contract W-7405-eng-36)
(DE93-003693; LA-UR-92-3235; CONF-9208188-1) Avail: CASI HC A02/MF A01

Recent progress toward classifying low-dimensional chaos measured from time series data is described. This classification theory assigns a template to the time series once the time series is embedded in three dimensions. The template describes the primary folding and stretching mechanisms of phase space responsible for the chaotic motion. Topological invariants of the unstable periodic orbits in the closure of the strange set

are calculated from the (reconstructed) template. These topological invariants must be consistent with any model put forth to describe the time series data, and are useful in invalidating (or gaining confidence in) any model intended to describe the dynamical system generating the time series. DOE

N93-22766# Colorado Univ., Boulder. Dept. of Astrophysical, Planetary, and Atmospheric Sciences.
CHAOTIC DYNAMICS IN ACCELERATOR PHYSICS
J. R. Cary 30 Nov. 1992 26 p
(Contract DE-FG02-86ER-40302)
(DE93-004600; DOE/ER-40302/7) Avail: CASI HC A03/MF A01

Substantial progress was made in several areas of accelerator dynamics. We have completed a design of an FEL wiggler with adiabatic trapping and detrapping sections to develop an understanding of longitudinal adiabatic dynamics and to create efficiency enhancements for recirculating free-electron lasers. We developed a computer code for analyzing the critical KAM tori that binds the dynamic aperture in circular machines. Studies of modes that arise due to the interaction of coating beams with a narrow-spectrum impedance have begun. During this research educational and research ties with the accelerator community at large have been strengthened. DOE

N93-22952# EG and G Energy Measurements, Inc., Idaho Falls.
GALILEO'S RELATIVITY PRINCIPLE, THE CONCEPT OF PRESSURE, AND COMPLEX CHARACTERISTICS, FOR THE SIX-EQUATION, ONE-PRESSURE MODEL
H. Makowitz Oct. 1992 27 p
(Contract DE-AC07-76ID-01570)
(DE93-005240; EGG-MS-10535) Avail: CASI HC A03/MF A01

We have studied various formulations of the concept of pressure, in the context of the usual Six-Equation Model of thermal-hydraulics. A different concept of pressure, than the usual one, has been used. This new pressure concept is Galilean Invariant, and results for the One-Pressure Model with the same complex characteristic roots as the 'Basic 3-Posed Model', discussed in the literature for the cases we have investigated. We have also examined several Two-Pressure formulations and shown that two pressures are a necessary but not sufficient condition for obtaining a Well-Posed system. Several counter examples are presented. We have shown that the standard theory is not Galilean Invariant and suggested that the origin of 3-Posedness is due to our closure relationships. We also question whether the current theory can satisfy conservation principles for mass, energy, and momentum. DOE

N93-23028# Stanford Univ., CA. Dept. of Physics.
THERMODYNAMIC AND STOCHASTIC THEORY OF HYDRODYNAMIC AND POWER-PRODUCING PROCESSES
J. Ross 16 Sep. 1992 8 p
(Contract DE-FG03-86ER-13479)
(DE93-006891; DOE/ER-13479/T2) Avail: CASI HC A02/MF A01

Thermodynamics of the transport processes of diffusion, thermal conduction, and viscous flow at a macroscopic level are developed for the simplest cases of one-dimensional transport in fluids for individual linear and nonlinear processes approaching a stationary non-equilibrium state. Formulation has started of thermodynamic and stochastic theory of combinations of transport processes. Global thermodynamic and stochastic theory of open chemical systems far from equilibrium is continued with analysis of a broad class of isothermal, multicomponent reaction mechanisms with multiple steady states with assumed local equilibrium. Stationary solutions are obtained of the master equation for single and multi-intermediate autocatalytic chemical systems. A kinetic potential is identified that governs the deterministic time evolution of coupled tank reactors. A second-order response theory was developed to investigate the effects of external periodic perturbations on a chemical reaction. DOE

N93-23683# Brigham Young Univ., Provo, UT.
INVESTIGATION OF COLD NUCLEAR FUSION IN CONDENSED MATTER Progress Report
S. E. Jones, M. Berrondo, J. B. Czirr, D. L. Decker, K. Harrison, G. L. Jenson, E. P. Palmer, L. B. Rees, D. S. Shelton, and S. Taylor et al 29 Dec. 1992 24 p
(Contract DE-FG02-90ER-12105)
(DE93-006083; DOE/ER-12105/2) Avail: CASI HC A03/MF A01

Recent research has been directed towards finding means to produce neutron emissions at will, to demonstrate reproducibility, and to permit in-depth studies of the origin of neutron emissions. This goal has been pursued in the Kamiokande detector in Japan and has led to the development of a deep underground laboratory in a tunnel in the Wasatch mountains near Brigham Young University. New counters for low-level neutron emissions are being utilized. Calorimetric tools have also been developed. DOE

N93-24005# National Inst. of Standards and Technology, Gaithersburg, MD. Applied and Computational Mathematics Div.
THERMODYNAMICALLY-CONSISTENT PHASE-FIELD MODELS FOR SOLIDIFICATION
S. L. Wang (Carnegie-Mellon Univ., Pittsburgh, PA.), R. F. Sekerka (Carnegie-Mellon Univ., Pittsburgh, PA.), A. A. Wheeler (Bristol Univ., England.), B. T. Murray, S. R. Coriell, R. J. Braun, and G. B. McFadden Nov. 1992 26 p Prepared in cooperation with Carnegie-Mellon Univ., Pittsburgh, PA, and Bristol Univ. (England)
(PB93-139012; NISTIR-4956) Avail: CASI HC A03/MF A01

In an effort to unify the various phase-field models that have been used to study solidification, we have developed a class of phase-field models for crystallization of a pure substance from its melt. These models are based on an entropy functional, as in the treatment of Penrose and Fife, and are therefore thermodynamically consistent inasmuch as they guarantee spatially local positive entropy production. General conditions are developed to ensure that the phase field takes on definite values, independent of temperature, for the bulk phases. Specific forms of a phase-field function are chosen to produce two models that bear strong resemblances to the models proposed by Langer and Kobayashi. Our models contain additional nonlinear functions on the phase field that are necessary to guarantee thermodynamic consistency. GRA

N93-24293 Lehigh Univ., Bethlehem, PA.
SPATIAL DEVELOPMENT OF CHAOS IN AN OPEN FLOW SYSTEM Ph.D. Thesis
Joseph Hanley 1992 181 p
Avail: Univ. Microfilms Order No. DA9302821

We study the spatial development of chaos in an open flow system. The temporal evolution of chaos has been widely studied in many systems. To better understand fully complex flow phenomena such as fluid turbulence we have investigated a system that showed a transition from spatially simple to spatially complex structures, while freezing out the temporal structures. The experimental arrangement to study this problem consists of a vertical axi-symmetric jet of water, with suitable additives, impinging onto a horizontal disk. The jet expands radially and forms a circular hydraulic jump. The hydraulic jump is a standing wave phenomenon and thus effectively freezes the flow patterns in space. The control parameters for this system are nozzle size, nozzle to disk spacing, volume flowrate and the fluid properties, specifically surface tension and viscosity. As flowrate is increased a temporally stable ring structure develops inside the jump. At higher flowrates an increasing number of rings are observed with decreasing spacing. When the number of rings reaches 5 or 6 the system undergoes a transition, specifically, a periodic radial modulation on the innermost ring, indicating a further decrease in length scales. At higher flowrates the modulations extend radially out encompassing more rings and the number of wavelengths on the innermost ring increases, showing a further decrease in length scales. At higher flowrates the system develops a time dependent behavior, indicating a fully turbulent regime. The dependence of these flow features on dimensional groups are derived experimentally. The form of the scaling parameters provides an insight to the physics that governs the flow development. Surface tension was found to have a more dominant effect than viscosity on the ring formation indicating the importance of capillary waves. The dissertation includes an extensive discussion of the experimental techniques, namely optical imaging and surface topology measurements, and defines the parameter space for the formation of temporally stable patterns. We conclude that we observe, for the first time, an open flow system that shows chaos developing solely in space. The route to spatial chaos is analogous to the temporal evolution to infinitely many time scales. Dissert. Abstr.

N93-24449# Lawrence Livermore National Lab., CA.
ACTUATOR STROKE REQUIREMENTS BASED ON A ZERNIKE DECOMPOSITION OF ATMOSPHERIC TURBULENCE
T. R. Kurfess and B. M. Levine 14 Sep. 1992 13 p
(Contract W-7405-eng-48)
(DE93-007393; UCRL-ID-111968) Avail: CASI HC A03/MF A01

This is a Mathematica Note Book that is used to compute the stroke requirements for individual actuators. The strokes are given as a function of frequency. The analysis assumes that both piston and tip/tilt (the first two Zernike modes) have been removed by a separate set of optics. The requirements presented here assume a Komgorov spectrum with a Rytov approximation. Furthermore, the equations for the power spectral density of the atmosphere are simplified somewhat. These simplifications and their justifications are presented in this technical brief. This brief is based on the JPL technical brief, 'Space Time Power Spectral Density Representations for Atmospheric disturbances,' by Marty Levine which summarizes a presentation by Albert Lazzarini given on 6 July 1992 at JPL. DOE

N93-24509# Surrey Univ., Guildford (England). Dept. of Electronic and Electrical Engineering.
ION BEAM MIXING IN MULTI-QUANTUM WELL STRUCTURES Final Report
Bernard L. Weiss 20 Sep. 1992 13 p
(Contract DAJA45-89-C-0040)
(AD-A259772) Avail: CASI HC A03/MF A01

The aims of the project were to investigate impurity induced disordering, using ion implantation, for the fabrication of optical waveguides in Aluminum Gallium Arsenide/Gallium Arsenide quantum well structures. Research prior to the initiation of the contract had indicated that the extent of the disordering, as measured by photoluminescence, was determined by both the nature, energy and dose of the implanted ion, and the temperature and time of the annealing process. While encouraging results were obtained for the loss characteristics of disorder delineated stripe optical waveguides, it was clear that not enough was known about the properties of the disordered QW structures to enable low loss disorder delineated strip optical waveguides to be designed and fabricated in AlGaAs/GaAs MQW structures. In addition the impurity chosen to disorder the QW was also of importance and a detailed evaluation of the appropriate ion suggested that some of the less common impurities would probably be more suitable for photonic devices. GRA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N93-23140*# Johns Hopkins Univ., Columbia, MD. Applied Physics Lab.
FIRST NATIONAL SPACE GRANT CONFERENCE REPORT
1990 129 p Conference held in Columbia, MD, 17-19 Jan. 1990 Sponsored by NASA
(NASA-EP-275; NAS 1.19:275) Avail: CASI HC A07/MF A02

The main business of the conference centered around a series of 15 workshops in which 15 program directors of their designates discussed various components of the Space Grant Program. On the basis of the workshops and conference discussion, the workshop facilitators redrafted and edited the reports, and these reports are presented. The topics covered include: an evaluation of the NASA Space Grant Consortia Programs; pre-college and college education; the use of continuing adult education; publicity and public relations; underrepresented groups; outreach and public service; state and local governments; university-industry interaction; program management; and use of fellowships. For individual titles, see N93-23141 through N93-23155.

N93-23141*# Florida Univ., Gainesville. Space Grant Consortium.
EVALUATION OF NASA SPACE GRANT CONSORTIA PROGRAMS
Martin A. Eisenberg *In* JHU, First National Space Grant Conference Report 1990 p 9-14 (For primary document see N93-23140 08-80)
Avail: CASI HC A02/MF A02

The meaningful evaluation of the NASA Space Grant Consortium and Fellowship Programs must overcome unusual difficulties: (1) the program, in its infancy, is undergoing dynamic change; (2) the several state consortia and universities have widely divergent parochial goals that defy a uniform evaluative process; and (3) the pilot-sized consortium programs require that the evaluative process be economical in human costs less the process of evaluation comprise the effectiveness of the programs they are meant to assess. This paper represents an attempt to assess the context in which evaluation is to be conducted, the goals and limitations inherent to the evaluation, and to recommend appropriate guidelines for evaluation. Author

N93-23142*# Pennsylvania State Univ., University Park. Space Grant Coll.
PRE-COLLEGE EDUCATION
Sylvia Stein *In* JHU, First National Space Grant Conference Report 1990 p 15-18 (For primary document see N93-23140 08-80)
Avail: CASI HC A01/MF A02

Pre-college education efforts are many and varied, involving the teachers, students, parents, museums, and youth groups. However, it is necessary to reach out to school administration at all levels if teachers are to be innovative in their approaches. This introductory meeting clearly indicated that more interaction between the participants would be profitable. It is clear that the science pipeline leading from kindergarten to college entry needs to be filled with students. What is not clear is how we can do it. The plethora of projects being pursued by the NASA Space Grant College Fellowship (NSGC) programs to accomplish that goal are heartening and exciting. However, this large gamut of programs may also indicate how new we are in this game and how little anyone knows about creating a pre-college interest in science and engineering. In a way, it resembles the situation of the common cold--there is no known cure yet, so there are many so-called remedies. Unfortunately, the time we had together was entirely too short to address the evaluation situation, so that we can in the future zero in on the most effective approaches. This report is a summary of the many ways the different NSGC' s are approaching pre-college education and a list of suggestions. Author

N93-23143*# California Univ., San Diego, La Jolla. Space Grant Consortium.
COLLEGE EDUCATION
David R. Criswell *In* JHU, First National Space Grant Conference Report 1990 p 19-32 (For primary document see N93-23140 08-80)
Avail: CASI HC A03/MF A02

Space Grant Colleges and Universities must build the space curriculum of the future on the firm basis of deep knowledge of an involvement with the present operating programs of the nation and an on-going and extensive program of leading edge research in the aerospace sciences and engineering, management, law, finance, and the other arts that are integral to our planetary society. The Space Grant College and Fellowship Program must create new academic fields of enquiry, which is a long and difficult process that will require deeper and broader interaction between NASA and academia than has previously existed. Author

N93-23144*# Utah State Univ., Logan. Space Grant Consortium.
THE USE OF CONTINUING ADULT EDUCATION
Frank J. Redd *In* JHU, First National Space Grant Conference Report 1990 p 33-37 (For primary document see N93-23140 08-80)
Avail: CASI HC A01/MF A02

The objectives of the National Space Grant and Fellowship Program include the expansion of space-oriented educational programs beyond the traditional boundaries of university campuses to reach 'non-traditional' students whose personal and professional lives would be enhanced by access to such programs. These objectives coincide with those of the continuing education programs that exist on most university campuses. By utilizing continuing educations resources and facilities, members of the National Space Grant Program can greatly enhance the achievement of program objectives. Author

N93-23145*# Colorado Univ., Colorado Springs. Space Grant Consortium.
PUBLICITY AND PUBLIC RELATIONS
Charles E. Fosha *In* JHU, First National Space Grant Conference Report 1990 p 38-41 (For primary document see N93-23140 08-80)
Avail: CASI HC A01/MF A02

This paper addresses approaches to using publicity and public relations

to meet the goals of the NASA Space Grant College. Methods universities and colleges can use to publicize space activities are presented. Author

N93-23146*# Georgia Inst. of Tech., Atlanta. Space Grant Consortium.
UNDERREPRESENTED GROUPS
David A. Peters *In* JHU, First National Space Grant Conference Report 1990 p 43-47 (For primary document see N93-23140 08-80)
Avail: CASI HC A01/MF A02

The problem with the shortage of under represented groups in science and engineering is absolutely crucial, especially considering that U.S. will experience a shortage of 560,000 science and engineering personnel by the year 2010. Most studies by the National Science Foundation also concluded that projected shortages cannot be alleviated without significant increases in the involvement of Blacks, Hispanics, Native Americans, handicapped persons, and women. Author

N93-23147*# Alabama Univ., Huntsville. Space Grant Consortium.
OUTREACH AND PUBLIC SERVICE
Harold J. Wilson *In* JHU, First National Space Grant Conference Report 1990 p 48-54 (For primary document see N93-23140 08-80)
Avail: CASI HC A02/MF A02

The Alabama Space Grant Consortium plan for outreach and public service is presented as a model for study and discussion. It is consistent with the objectives of the Space Grant Program and expresses a strong commitment to cooperation between academia, industry, and government. Author

N93-23148*# Michigan Univ., Ann Arbor. Space Grant Consortium.
PIPELINE ISSUES
Joe T. Eisley *In* JHU, First National Space Grant Conference Report 1990 p 55-63 (For primary document see N93-23140 08-80)
Avail: CASI HC A02/MF A02

The declining pool of graduates, the lack of rigorous preparation in science and mathematics, and the declining interest in science and engineering careers at the precollege level promises a shortage of technically educated personnel at the college level for industry, government, and the universities in the next several decades. The educational process, which starts out with a large number of students at the elementary level, but with an ever smaller number preparing for science and engineering at each more advanced educational level, is in a state of crisis. These pipeline issues, so called because the educational process is likened to a series of ever smaller constrictions in a pipe, were examined in a workshop at the Space Grant Conference and a summary of the presentations and the results of the discussion, and the conclusions of the workshop participants are reported. Author

N93-23149*# Virginia Univ., Charlottesville. Space Grant Consortium.
STATE AND LOCAL GOVERNMENTS
Dennis Barnes *In* JHU, First National Space Grant Conference Report 1990 p 64-69 (For primary document see N93-23140 08-80)
Avail: CASI HC A02/MF A02

The Virginia Space Grant Consortium approach to a close working relation to state and local governments is presented as a model for consideration. State government relations are especially important in that this is a primary resource in securing matching funds. Avenues for establishing these relationships are listed and discussed. Author

N93-23150*# Washington Univ., Seattle. Space Grant Coll.
FOCUSING EDUCATIONAL INITIATIVES
George K. Parks *In* JHU, First National Space Grant Conference Report 1990 p 70-75 (For primary document see N93-23140 08-80)
Avail: CASI HC A02/MF A02

The United States will soon be facing a critical shortage of aerospace scientists and engineers. To address this problem, Space Grant Colleges can assist in focusing interest in existing educational initiatives and in creating new educational opportunities, particularly for women and underrepresented minorities. Author

N93-23151*# Massachusetts Inst. of Tech., Cambridge. Space Grant Program.
UNIVERSITY-INDUSTRY INTERACTION
Daniel E. Hastings *In* JHU, First National Space Grant Conference Report 1990 p 76-82 (For primary document see N93-23140 08-80)
Avail: CASI HC A02/MF A02

It is posited that university industry interaction is highly desirable from the viewpoint of the long term economic development of the country as well as being desirable for the Space Grant Programs. The present and future possible interactions are reviewed for the three university levels namely, undergraduate, graduate, and faculty research. Author

N93-23152*# Texas Univ., Austin. Space Grant Consortium.
ORGANIZATION AND MANAGEMENT OF SPACE GRANT PROGRAMS
Sallie Sheppard and Steve Nichols *In* JHU, First National Space Grant Conference Report 1990 p 83-90 (For primary document see N93-23140 08-80)
Avail: CASI HC A02/MF A02

The 21 Space Grant Programs represent a broad range of organizational structures which operate programs ranging in size from single university organizations to organizations including up to 41 members involving a composite of industrial organizations such as state agencies, and universities. Some of the space grant awards were made to organizations already in existence with on-going programs while other awards were made to consortia newly formed for the purpose of applying to the Space Grant Program. The workshop on organization and management of Space Grant Programs provided an opportunity for directors and program representatives to discuss and compare the relative advantages and disadvantages of the various models being used. This paper offers examples of the diversity of organizations, summarizes the common concerns to be met by each organizational model, and provides a case study of the Texas Space Grant Consortium organization. Author

N93-23153*# Cincinnati Univ., OH. Aerospace Inst. Space Grant Consortium.
COMMUNICATIONS
Donald D. Stouffer *In* JHU, First National Space Grant Conference Report 1990 p 91-93 (For primary document see N93-23140 08-80)
Avail: CASI HC A01/MF A02

Communication in its many forms is a critical component for an effective Space Grant Program. Good communication is needed within individual Space Grant College/Consortia, for example between consortium affiliates and the consortium program office. Effective communication between the several programs, NASA Headquarters, and NASA field centers also is required. Further, communication among the above program elements, industry, local and state government, and the public also are necessary for meeting program objectives. Author

N93-23154*# Cornell Univ., Ithaca, NY. Space Grant Coll.
USE OF FELLOWSHIPS
Peter J. Gierasch *In* JHU, First National Space Grant Conference Report 1990 p 94-98 (For primary document see N93-23140 08-80)
Avail: CASI HC A01/MF A02

The effective use of Space Grant Program fellowships are critical in meeting program objectives. In the first year of operation, the 21 colleges/consortia will expend from 30-40 percent of their grants for fellowships; program policy will allow up to 50 percent to be spent for fellowships. Thus, fellowship policy must be carefully implemented and monitored. Author

N93-23155*# Arizona Univ., Tucson. Space Grant Consortium.
PITFALLS
Terry Triffet *In* JHU, First National Space Grant Conference Report 1990 p 99-102 (For primary document see N93-23140 08-80)
Avail: CASI HC A01/MF A02

Though potentially of great benefit to the nation, the experience of the workshop participants and their discussions with Sea Grant and Land Grant officials make it clear that the Space Grant Program must avoid certain pitfalls of the past and present if it is to be successful. The most important of these are listed and briefly discussed. Author

N93-23174*# National Aeronautics and Space Administration, Washington, DC.
NASA'S STRATEGIC PLAN FOR EDUCATION. A STRATEGY FOR

CHANGE, 1993-1998
Dec. 1992 76 p
(NASA-EP-289; NAS 1.19:289) Avail: CASI HC A05/MF A01

NASA's education vision is to promote excellence in America's education system through enhancing and expanding scientific and technological competence. In doing so, NASA strives to be recognized by the education community as the premier mission agency in support of the National Education Goals and in the development and implementation of education standards. To realize this vision, NASA has clearly defined and developed three specific goals to promote excellence in education. Specific objectives and milestones are defined for each goal in the body of this strategic plan. Derived from text

N93-23250*# National Aeronautics and Space Administration, Washington, DC.
NASA'S EDUCATION PROGRAM INVENTORY FY 91
Aug. 1992 87 p
(NASA-EP-284; NAS 1.19:284) Avail: CASI HC A05/MF A01

In 1988, the Education Division produced an inventory of NASA-supported education programs. Since then, mathematics, science, and technology education has taken on a more visible role, not only as part of NASA's mission, but as part of the National Education Goals and other Federal initiatives. Therefore, it became important to update the 1988 inventory in order to achieve a more accurate and comprehensive look at NASA's educational programs. The data collected is summarized and descriptions of each program are provided. Derived from text

N93-24583# Executive Office of the President, Washington, DC.
IN THE NATIONAL INTEREST: THE FEDERAL GOVERNMENT AND RESEARCH-INTENSIVE UNIVERSITIES
Dec. 1992 67 p
(PB93-140135) Avail: CASI HC A04/MF A01

Seventeen agencies developed a Federal government perspective on its relationship with research-intensive universities both now and for the future. Three key themes are conveyed. First, it describes the broad, complex, and interdependent relationship that has developed between research-intensive universities and the Federal government. Second, it identifies critical trends and issues that are affecting this relationship. And third, it reaffirms principles and makes recommendations whose purpose is to assure that the relationship between the Federal government and the research-intensive universities is maintained, nurtured, and enhanced. Author (revised)

N93-23824# Ministere de l'Education Nationale, Paris (France). Direction des Lycees et Colleges.
SPACE TECHNOLOGIES IN FRENCH EDUCATION [LES TECHNOLOGIES SPATIALES DANS L'EDUCATION EN FRANCE]
A. Elie *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1329-1330 In FRENCH (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23826# United Nations, New York, NY. Outer Space Affairs Div.
CENTRES FOR SPACE SCIENCE AND TECHNOLOGY EDUCATION: A UNITED NATIONS INITIATIVE
Adigun Ade Abiodun *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1337-1341 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23828# Nairobi Univ. (Kenya). Dept. of Electrical and Electronic Engineering.
THE TROPICAL SCHOOL FOR ATMOSPHERIC AND SPACE SCIENCES: AN INTERNATIONAL PROJECT PROPOSAL
Robert JallangoAkello *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1347-1351 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23829# Ministere de l'Education Nationale, Paris (France). Direction des Lycees et Colleges.
REMOTE SENSING SATELLITE AND THEMATIC APPLICATIONS IN HIGH SCHOOLS AND ELEMENTARY SCHOOLS IN FRANCE [SATELLITE DE TELEDETECTION ET APPLICATIONS THEMATIQUES DANS LES LYCEES ET COLLEGES EN FRANCE]
M. Vauzelle *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1353-1355 In FRENCH Preprared in cooperation with CNES, Paris, France (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23830# Gymnasium Neuenbuerg (Germany).
SATELLITE-IMAGES IN SECONDARY EDUCATION IN BADEN-WUERTTEMBERG (GERMANY)
Bruno Pohl *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1357-1361 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23831# Wuhlheide Leisure und Recreation Centre, Berlin (Germany).
SPACE RESEARCH AS A TOOL TO ACQUAINT CHILDREN AND YOUNG PEOPLE WITH SCIENCE AND TECHNOLOGY
Werner Bachmann and Judika Jentsch *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1363-1367 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N93-22465*# National Aeronautics and Space Administration, Washington, DC.
SSTAC/ARTS REVIEW OF THE DRAFT INTEGRATED TECHNOLOGY PLAN (ITP). VOLUME 5: HUMAN SUPPORT
28 Jun. 1991 189 p Meeting held in McLean, VA, 24-28 Jun. 1991
(NASA-TM-108653; NAS 1.15:108653) Avail: CASI HC A09/MF A02

Viewgraphs of briefings from the Space Systems and Technology Advisory Committee (SSTAC)/ARTS review of the draft integrated technology plan (ITP) on human support are included. Topics covered include: human support program; human factors; life support technology; fire safety; medical support technology; advanced refrigeration technology; EVA suit system; advanced PLSS technology; and ARC-EVA systems research program. CASI

N93-22904# Environmental Protection Agency, Washington, DC. Office of the Assistant Administrator for Water.
FRAMEWORK FOR DECISION MAKING: AN EPA PERSPECTIVE
Stig Regli, John E. Cromwell, Xin Zhang, Allen B. Gelderloos, and William D. Grubbs Aug. 1992 82 p
(PB93-134369; EPA/811/R-92/005) Avail: CASI HC A05/MF A01

The United States Environmental Protection Agency (EPA) is developing national regulations to control for disinfectants and disinfection by-products (D/DBP's) in public drinking water supplies. EPA intends to propose regulations that will apply to all public water systems using disinfection

and serving non-transient populations--approximately 220 million people. This regulation would be unlike the current maximum contaminant level (MCL) for total trihalomethanes (TTHM's) which only pertains to systems serving more than 10,000 people. A fundamental goal in setting any new regulation is to be able to conclude with confidence that the resultant changes in treatment would lead to a significant overall decrease in risk to public health. This paper will describe the analysis that EPA is undertaking in pursuit of meeting this goal. GRA

N93-22982# Oak Ridge National Lab., TN.
TECHNOLOGY AND THE 21ST CENTURY GOVERNMENT ORGANIZATION
B. E. Tonn, M. S. Bronzini, R. T. Goeltz, M. Hilliard, and M. Irby 1992 11 p Presented at the 5th Advanced Technology Conference of the United States Postal Service, Washington, DC, 30 Nov. - 2 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-002506; CONF-9211120-1) Avail: CASI HC A03/MF A01

This paper presents a conceptual design for the 21st Century government organization. This design is applicable to the future US Postal Service and generalizable to other large government agencies. The design is based on conjectures in three areas: capabilities of information technology in the early 21st Century; motivations, needs, strengths, and weaknesses of members of the 21st Century workforce; and needs of large public organizations. The design addresses topics such as coordination, career tracks, communications, and the seamless integration of information resources. DOE

N93-23074# Carnegie Commission on Science, Technology, and Goverment, New York, NY.
SCIENCE, TECHNOLOGY, AND THE STATES IN AMERICA'S THIRD CENTURY
Sep. 1992 75 p
(ISBN-1-881054-03-9) Avail: CASI HC A04/MF A01

This report of the Carnegie Commission on Science, Technology, and Government was prepared by the Task Force on Science and Technology and the States. The Commission was established in April 1988 to assess the mechanisms by which the federal government and the states incorporate scientific and technological knowledge into policymaking processes. The Commission formed the task force in 1991 to study a key level of this nation's government that, in earlier studies of the Commission, had been examined only tangentially. The task force held its first meeting 9-10 Sep. 1991, in Middleburg, Va. Subsequent meetings were held 15-16 Mar. 1992, in Deerfield Beach, Fla., and 14 May 1992, in Washington, DC. The task force was chaired by former governor and Advisory Council member Richard F. Celeste. The task force members were William O. Baker, Arden L. Bement, Erich Bloch, Lawton Chiles, Daniel J. Evans, B. R. Inman, H. Graham Jones, Frank E. Moiser, Walter H. Plosila, Donna Shalala, Luther Williams, Linda S. Wilson, and Charles E. Young. Christopher M. Coburn was the staff director for the task force. Commission staff members who worked with the task force and contributed to the development of the report were David Z. Robinson, Maxine L. Rockoff, Jonathan Bender, and David M. Kirch. Thomas H. Moss also assisted the task force. The task force is grateful to Harvey Brooks for his interest and invaluable insight. The final report was drafted by Duncan M. Brown, and the manuscript was edited by Jeannette L. Aspden. The report is endorsed by the task force and was approved by the Commission at its June 1992 meeting.
Author (revised)

N93-23109*# National Aeronautics and Space Administration, Washington, DC.
SSTAC/ARTS REVIEW OF THE DRAFT INTEGRATED TECHNOLOGY PLAN (ITP). VOLUME 3: SPACE POWER AND THERMAL MANAGEMENT
28 Jun. 1991 321 p Meeting held in McLean, VA, 24-28 Jun. 1991
(NASA-TM-108652; NAS 1.15:108652) Avail: CASI HC A14/MF A03

Viewgraphs of briefings from the SSTAC/ARTS review of the draft integrated technology plan on thermal power and thermal management are presented. Topics covered include: space energy conversion research and technology; space photovoltaic energy conversion; chemical energy conversion and storage; thermal energy conversion; power management; thermal management; space nuclear power; high capacity power; surface power and thermal management; space platforms power and thermal management; and project SELENE. CASI

N93-23286# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992. REGION 4: ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, SOUTH CAROLINA, AND TENNESSEE
Nov. 1992 104 p
(PB93-110955) Avail: CASI HC A06/MF A02

SBA region 4 consists of the following states: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. The report discusses small business, women-and-minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-23376# General Accounting Office, Washington, DC.
NASA CONTRACT MANAGEMENT
Dec. 1992 42 p
(GAO/HR-93-11) Avail: CASI HC A03/MF A01; GAO, PO Box 6015, Gaithersburg, MD 20877 HC

In January 1990, in the aftermath of scandals at the Department of Defense and Housing and Urban Development, the General Accounting Office began a special effort to review and report on federal government program areas that we considered 'high risk.' After consulting with congressional leaders, GAO sought, first, to identify areas that are especially vulnerable to waste, fraud, abuse, and mismanagement. We then began work to see whether we could find the fundamental causes of problems in these high-risk areas and recommend solutions to the Congress and executive branch administrators. We identified 17 federal program areas as the focus of our project. These program areas were selected because they had weaknesses in internal controls (procedures necessary to guard against fraud and abuse) or in financial management systems (which are essential to promoting good management, preventing waste, and ensuring accountability). Correcting these problems is essential to safeguarding scarce resources and ensuring their efficient and effective use on behalf of the American taxpayer. This report is one of the high-risk series reports, which summarize our findings and recommendations. It describes our concerns over the National Aeronautics and Space Administration's (NASA) lack of adequate controls over a variety of contract management and related activities. NASA has implemented or begun to implement most of the recommendations we have made for improving these activities. NASA has also implemented other contract management improvement initiatives.
Derived from text

N93-23434# George Mason Univ., Fairfax, VA. Center of Excellence in Command, Control, Communications and Intelligence.
THE IMPACT ON ORGANIZATION STRUCTURE ON TEAM DECISION MAKING UNDER STRESS AND UNCERTAINTY Quarterly Technical Report, 16 Sep. - 15 Dec. 1992
Paul E. Lehner and Alexander H. Levis 5 Jan. 1993 19 p
(Contract N00014-90-J-1680)
(AD-A259831; GMU/C3I-126-IR) Avail: CASI HC A03/MF A01

The objective of the research reported herein is to investigate coordination in team decision making. Particular focus is placed on the identification and characterization of variables that enhance coordination and enable teams to maintain coordinated action under stressful conditions characteristic of tactical environments. GRA

N93-23437# Small Business Administration, Washington, DC. Office of Advocacy.
STATE OF SMALL BUSINESS: A REPORT OF THE PRESIDENT TRANSMITTED TO THE CONGRESS Annual Report
1992 488 p
(PB93-137073; ISBN-0-16-037942-3) Avail: CASI HC A21/MF A04; SOD HC

The annual report of the president to Congress is prepared by the Small Business Administration's Office of Advocacy. It reports on the current economic climate for small businesses, including job creation, business formation, earnings, failure and bankruptcy rates, and the outlook for new and small businesses. Derived from text

N93-23446# Department of Defense, Washington, DC.
YOU WANT IT WHEN: A TQM GUIDE TO CUSTOMER SERVICE
Sep. 1992 21 p
(PB93-154540) Avail: CASI HC A03/MF A01

The intention of the booklet is to give you the information needed to give great customer service. Various aspects of total quality management (TQM) are discussed. GRA

N93-23447# Department of Energy, Richland, WA.
TOTAL QUALITY IMPLEMENTATION GUIDE
2 Oct. 1992 26 p
(PB93-154524) Avail: CASI HC A03/MF A01

The purpose of the Implementation Guide is to communicate and to document the Quality Council's design of the elements to implement Total Quality (TQ) within the Richland Field Office (RL) organization. GRA

N93-23466# Klein Associates, Inc., Yellow Springs, OH.
ADVANCED TEAM DECISION MAKING: A DEVELOPMENTAL METHOD
Caroline E. Zsambok, Gary Klein, Molly M. Kyne, and David W. Klinger 3 Aug. 1992 28 p
(Contract MDA903-90-C-0117)
(AD-A259512) Avail: CASI HC A03/MF A01

This document describes Advanced Team Decision Making: A Developmental Model (ATDM). Based on our observations of numerous tactical and strategic decision making teams, and on a review of relevant literature, Klein Associates derived three key components of advanced team decision making: team self identity, team conceptual level, and team self monitoring. The model contains ten key behaviors critical to team development in these components. We developed this document for the Industrial College of the Armed Forces. It describes the ATDM model in language compatible with the needs of ICAF students who are being trained to transition into strategic-level leadership positions. ATDM was first introduced in ICAF's 1992 curriculum. This document is the second of three components of the team training program Klein Associates designed for ICAF. The first component is an introductory lecture about ATDM (called Lesson 1111 in this document) that we delivered to the faculty and student body. The third component (called Lesson 1311) is an exercise designed for experiential learning. The exercise and facilitated after-action review sessions give students an opportunity to practice, discuss, and improve their team decision-making skills in a manner consistent with the ATDM model. Copies of this document are also available from Klein Associates. GRA

N93-23680# Executive Office of the President, Washington, DC.
LEARNING TO MEET THE SCIENCE AND TECHNOLOGY CHALLENGE
Dec. 1992 60 p
(PB93-139996) Avail: CASI HC A04/MF A01

The report provides some recommendations for reviving the U.S.'s leadership role in science and technology. Special attention is given to the development of a strong educational base for training the scientists and engineers of the future. The reports lists progress goals for all levels of education based on the National Education Goals established in 1990. The objective of the report is not to resolve all educational problems but rather to deal with a complex set of problems in a realistic and useful way. GRA

N93-23698# University of Central Florida, Orlando.
THE STUDY OF CREW COORDINATION AND PERFORMANCE IN HIERARCHICAL TEAM DECISION MAKING Interim Report
Clint A. Bowers, Julie M. Urban, and Ben B. Morgan, Jr. Nov. 1992 78 p
(Contract N00014-90-J-1846)
(AD-A259514; TR-92-01) Avail: CASI HC A05/MF A01

This report describes the theoretical foundations, methodology, and initial results of an ongoing empirical investigation of team decision making. The theoretical foundations are based on the team process and performance literature, which is discussed in terms of a broad model of team performance. To allow for the measurement of various elements of team performance depicted in the model, a computerized testbed has been developed. This testbed, the Team Performance Assessment Battery (TPAB), includes team and individual tasks arranged according to a synthetic work methodology. Using TPAB, an empirical study has been performed in which team structure and workload were manipulated in a between groups design. The results of this study are interpreted in the context of the team performance model. Implications for future research are also discussed. GRA

N93-23954# Air Univ., Maxwell AFB, AL. Airpower Research Inst.
TOTAL QUALITY MANAGEMENT: GOOD ENOUGH FOR GOVERNMENT WORK
Mike Prowse Oct. 1992 242 p
(AD-A259847; AU-ARI-90-9) Avail: CASI HC A11/MF A03

Changing the management foundation principles under which we work is addressd. The management principles discussed are based on the concept of strategic quality management, which includes total quality management (TQM). Total quality management covers the entire life cycle of an organization, including the organization's products or services. It is strategic to an organization because it deals not only with the internal environment but also the external environment. TQM goes beyond systems engineering to provide principles of organizational design, leadership, and human engineering. It is the system integrator in an organization, bringing together people, equipment, methods, and machines to effectively satisfy customer expectations. TQM is an organizational culture, a set of norms, and a way to perform the organization's functions. GRA

N93-23981# Aerospace Medical Research Labs., Brooks AFB, TX. Human Resources Directorate.
IMPLEMENTING TOTAL QUALITY MANAGEMENT (TQM) 1: THE COMMAND IMPERATIVE Interim Report, Nov. 1990 - Nov. 1991
Charles N. Weaver and Malcolm T. Upton Dec. 1992 23 p
(AF Proj. 7719)
(AD-A259885; AL-SR-1992-0012) Avail: CASI HC A03/MF A01

The role senior leadership must play in the Total Quality Management/Methodology for Generating Efficiency and Effectiveness Measures (TQM/MGEEM) process and philosophy is documented. Generally observed characteristics of DOD organization TQM implementations and their weaknesses are discussed. Successful TQM implementation depends on direct commander involvement in several areas of the TQM effort including training, empowerment through the Quality Council, establishment of measures, championing of TQM and the mission statement, and continual improvement efforts. Finally, a call to action is issued for the commanders, explaining that with their continual, visible commitment to a TQM effort, all else will follow and without this type of commitment, any efforts toward TQM are doomed to failure. GRA

N93-24157# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992. REGION 3: DELAWARE, DISTRICT OF COLUMBIA, MARYLAND, PENNSYLVANIA, VIRGINIA, AND WEST VIRGINIA
Nov. 1992 80 p
(PB93-110948) Avail: CASI HC A05/MF A01

Small Business Administration region 3 consists of the following states: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia. The report discusses small business, women- and minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-24158# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992. REGION 5: ILLINOIS, INDIANA, MICHIGAN, MINNESOTA, OHIO, AND WISCONSIN
Nov. 1992 78 p
(PB93-110963) Avail: CASI HC A05/MF A01

Small Business Administration region 5 consists of the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. The report discusses small business, women- and minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-24159# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992. REGION 6: ARKANSAS, LOUISIANA, NEW MEXICO, OKLAHOMA, AND TEXAS
Nov. 1992 63 p
(PB93-110971) Avail: CASI HC A04/MF A01

Small Business Administration region 6 consists of the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. The report discusses small business, women- and minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-24160# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992. REGION 9: ARIZONA, CALIFORNIA, HAWAII, AND NEVADA
Nov. 1992 54 p
(PB93-111003) Avail: CASI HC A04/MF A01

Small Business Administration region 9 consists of the following states: Arizona, California, Hawaii, and Nevada. The report discusses small business, women- and minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-24177# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992. REGION 2: NEW JERSEY AND NEW YORK
Nov. 1992 28 p
(PB93-110930) Avail: CASI HC A03/MF A01

SBA region 2 consists of the following states: New Jersey and New York. The report discusses small business, women-and minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-24285# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992: REGION 7: IOWA, KANSAS, MISSOURI, AND NEBRASKA
Nov. 1992 52 p
(PB93-110989) Avail: CASI HC A04/MF A01

Small Business Administration region 7 consists of the following states: Iowa, Kansas, Missouri, Nebraska. The report discusses small business, women- and minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-24303# Illinois Univ., Urbana.
PERMISSIVE PLANNING: A MACHINE-LEARNING APPROACH TO PLANNING IN COMPLEX REAL-WORLD DOMAINS M.S. Thesis
Scott W. Bennett Jan. 1993 128 p
(Contracts N00014-86-C-0309; N00014-91-J-1563)
(AD-A260019; UIUC-BI-AI-93-01) Avail: CASI HC A07/MF A02

Classical planning techniques have some serious problems when employed in real-world domains. In classical planning, it is assumed we know the current state of the world and can project that state through a reasonably well-defined set of actions to yield a future state. However, perfect models of the world and of operators are not possible in most domains. Consequently, discrepancies occur between the projected future state and the observed future state. In these complex domains, the success of the plan can never be guaranteed. Furthermore, an important tradeoff exists between the time spent constructing a plan and its resulting chance of success. Several approaches to these problems have been investigated, including the use of decision-theoretic methods and the incorporation of reactivity into planners. We present a new technique called permissive planning. Explicit approximations are employed in representing the world state and operators. Plans are then constructed efficiently using the approximate theory. In response to plan execution failures, plans are refined so they become less sensitive to the approximate knowledge used in their initial construction. This is achieved by tuning parameters of the plan so as to minimize the expected future deviation. Each permissive plan has a target success rate and a degree of confidence desired in that success rate. We present a formal permissive planning algorithm which can be shown to either produce a plan with the desired success rate and degree of confidence, if possible, or otherwise to return the plan failing short of the target but with the best possible success rate. GRA

N93-24305# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992. REGION 10: ALASKA, IDAHO, OREGON, AND WASHINGTON
Nov. 1992 54 p
(PB93-111011) Avail: CASI HC A04/MF A01

Small Business Administration region 10 consists of the following states: Alaska, Idaho, Oregon, and Washington. The report discusses small business, women- and minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-24306# Eastern Washington State Coll., Cheney, WA.
TOTAL QUALITY MANAGEMENT IN THE FEDERAL GOVERNMENT. IMPLEMENTATION OF TQM IN FEDERAL AGENCIES RECEIVING THE FEDERAL QUALITY INSTITUTE QUALITY IMPROVEMENT PROTOTYPE AWARD, 1990-1992
Claudia Drake Dec. 1992 84 p
(PB93-154573) Avail: CASI HC A05/MF A01

The paper attempts to analyze case studies of federal agencies which have been deemed successful at implementing total quality management (TQM) to (1) identify which components of TQM (based on W. Edwards Deming's Fourteen Points) are being implemented in those agencies, and (2) identify the pathway of implementation. As a result, it can be determined whether selected Federal Agencies have been able to implement all components of orthodox TQM, and which strategy or model for the implementation of TQM in Federal Government have been used successfully. GRA

N93-24413# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
AN EVALUATION OF SCHEDULE METRICS USED WITHIN AERONAUTICAL SYSTEMS CENTER M.S. Thesis
Robert J. Hayes and Lawrence M. Miller Sep. 1992 221 p
(AD-A260113; AFIT/GSM/LSY/92S-12) Avail: CASI HC A10/MF A03

This study focused on a selected group of schedule metrics in use at Aeronautical Systems Center (ASC) acquisition program offices. Over 300 metrics were collected from the System Program Offices (SPO's). The metrics data was sorted into the categories of cost, schedule, and performance. In order to narrow the scope of the project, the team decided to focus on schedule metrics. Seven of the most common schedule metrics were selected for evaluation by a group of five experienced acquisition professionals. The group was asked to input the likely behaviors driven by the metrics being addressed by the study. Next, they were asked to rate the metrics through a Group Support System at Armstrong Laboratory, Human Resources Division. The evaluation group rated how well the metric-driven behaviors contributed to continuous improvement. Results of the study showed a wide spread of behaviors, both positive and negative, that would likely be driven by the metrics. Most of the metrics rated were found to need improvement in terms of influencing behaviors that would lead to continuous improvement. However, many good metric-driven behaviors were identified and could prove helpful to program offices undergoing the challenge of developing their own internal metrics. GRA

N93-24556# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILES, 1992: REGION 1
Nov. 1992 79 p
(PB93-110922) Avail: CASI HC A05/MF A01

SBA Region 1 consists of the following states: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. The report discusses: Small Business, Women-and Minority-Owned Businesses, Comparative Economic Indicators and Economic Projection. GRA

N93-24557# Small Business Administration, Washington, DC. Office of Advocacy.
SMALL BUSINESS PROFILE, 1992. REGION 8: COLORADO, MONTANA, NORTH DAKOTA, SOUTH DAKOTA, UTAH, AND WYOMING
Nov. 1992 79 p
(PB93-110997) Avail: CASI HC A05/MF A01

Small Business Administration region 8 consists of the following states: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. The report discusses small business, women- and minority-owned businesses, comparative economic indicators, and economic projection. GRA

N93-24585# Executive Office of the President, Washington, DC. Office of the Vice President.
FUTURE OF THE US SPACE INDUSTRIAL BASE: A TASK GROUP REPORT
Nov. 1992 70 p
(PB93-139954) Avail: CASI HC A04/MF A01

The Task Group of the Vice President's Space Policy Advisory Board was appointed to identify the important issues which will affect the ability of the U.S.'s space industrial base to respond to the defense, civil, and commercial space objectives, and to recommend government policies and actions which will address these matters. GRA

N93-23510# Munich Reinsurance Co. (Germany).
INSURANCE COVER FOR SPACE VENTURES
Ernst Steilen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Navigation and Mobile Communications. Image Processing, GIS, and Space-Assisted Mapping Jul. 1992 p 15-18 (For primary document see N93-23507 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24357# Joanneum Research Centre, Graz (Austria). Applied Systems Technology Inst.
TECHNICAL MANAGEMENT AND TEST PROCEDURES FOR AUSTROMIR-1991
C. Feichtinger, B. Josseck, V. Berzhatyi (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), T. Batenchuk-Tusko (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR.), and V. Kozharinov (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 111-115 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N93-22017*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
METHOD AND APPARATUS FOR FILTERING VISUAL DOCUMENTS
Patent Application
Mark E. Rorvig, inventor (to NASA) and Robert O. Shelton, inventor (to NASA) 5 Feb. 1993 19 p
(NASA-Case-MSC-22093-1; NAS 1.71:MSC-22093-1; US-Patent-Appl-SN-014985) Avail: CASI HC A03/MF A01

A method and apparatus for producing an abstract or condensed version of a visual document is presented. The frames comprising the visual document are first sampled to reduce the number of frames required for processing. The frames are then subjected to a structural decomposition process that reduces all information in each frame to a set of values. These values are in turn normalized and further combined to produce only one information content value per frame. The information content values of these frames are then compared to a selected distribution cutoff point. This effectively selects those values at the tails of a normal distribution, thus filtering key frames from their surrounding frames. The value for each frame is then compared with the value from the previous frame, and the respective frame is finally stored only if the values are significantly different. The method filters or compresses a visual document with a reduction in digital storage on the ratio of up to 700 to 1 or more, depending on the content of the visual document being filtered. NASA

N93-22058# Department of Energy, Oak Ridge, TN. Office of Scientific and Technical Information.
DEPARTMENT OF ENERGY NEW TECHNOLOGY
A. Tamura, ed. and L. Kane, ed. Nov. 1992 107 p
(DE92-041170; DOE/ER-0535P-1) Avail: CASI HC A06/MF A02

The purpose of this publication is to provide information on how to access specific technologies developed through research sponsored by DOE and performed by DOE laboratories or by contracted researchers. Technologies identified as having potential for commercial applications are described in addition to a catalog of current patent applications and patents available for licensing for DOE and DOE contractors. DOE

N93-22435# Argonne National Lab., IL. Engineering Physics Div.
GENERATION OF COVARIANCE DATA AMONG VALUES FROM A SINGLE SET OF EXPERIMENTS
D. L. Smith 1992 13 p Presented at the Nuclear Energy Agency Science Committee Specialists Meeting on Evaluation and Processing of Covariance Data, Oak Ridge, TN, 7-9 Oct. 1992
(Contract W-31-109-eng-38)
(DE93-004192; ANL/EP/CP-78013; CONF-9210173-3) Avail: CASI HC A03/MF A01

Modern nuclear data evaluation methods demand detailed uncertainty information for all input results to be considered. It can be shown from basic statistical principles that provision of a covariance matrix for a set of data provides the necessary information for its proper consideration in the context of other included experimental data and/or a priori representations of the physical parameters in question. This paper examines how an experimenter should go about preparing the covariance matrix for any single experimental data set he intends to report. The process involves detailed examination of the experimental procedures, identification of all error sources (both random and systematic), and consideration of any internal discrepancies. Some specific examples are given to illustrate the methods and principles involved. DOE

N93-22495# Oak Ridge K-25 Site, TN.
OBJECT TECHNOLOGY: A WHITE PAPER
S. R. Jordan, L. F. Arrowood, W. D. Cain, W. M. Stephens, and B. D. Vickers 11 May 1992 171 p
(Contract DE-AC05-84OT-21400)
(DE93-006037; K/CSD/INF-92/27) Avail: CASI HC A08/MF A02

Object-Oriented Technology (OOT), although not a new paradigm, has recently been prominently featured in the trade press and even general business publications. Indeed, the promises of object technology are alluring: the ability to handle complex design and engineering information through the full manufacturing production life cycle or to manipulate multimedia information, and the ability to improve programmer productivity in creating and maintaining high quality software. Groups at a number of the DOE facilities have been exploring the use of object technology for engineering, business, and other applications. In this white paper, the technology is explored thoroughly and compared with previous means of developing software and storing databases of information. Several specific projects within the DOE Complex are described, and the state of the commercial marketplace is indicated. DOE

N93-22498# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
OCCURRENCE REPORTING AND PROCESSING SYSTEM (ORPS) LESSONS LEARNED: TOOLS TO IMPROVE WORKPLACE PERFORMANCE
S. L. Commander 1992 13 p Presented at the 16th Training Resources and Data Exchange: Managing for Performance and Results, Seattle, WA, 2-4 Nov. 1992
(Contract DE-AC07-76ID-01570)
(DE93-005241; EGG-M-92367; CONF-921187-3) Avail: CASI HC A03/MF A01

Various Department of Energy (DOE) orders require DOE and DOE contractor personnel to review abnormal events to gain lessons learned information. The term 'event' is used to mean a real-time occurrence. When reviewing events data, it must be possible to determine what happened and why (including root causes), the impacts, the appropriate corrective actions, and any lessons learned that might be applicable to activities of other operations or contractors. Merely obtaining the information will not prevent occurrence of a similar event; contributing conditions must be

corrected. It is important for managers, trainers, and others to learn from the events of others so that they may apply these experiences to their own activities. Reports of events must be analyzed to determine possible applicability to other facilities and/or job functions. Relevant information can then be used to correct defects and improve facilities and operations, thus making them more efficient and safer for all employees. Lessons learned information is particularly helpful in planning employee training and in developing training curriculum and programs. Lessons learned information can be obtained from many sources. It can be found in the Safety Performance Measurement System's Computerized Accident/Incident Reporting System (CAIRS) module, the S&H Publications module, the Unusual Occurrence Reports module, and the Office of Nuclear Safety 'Operating Experience Weekly Summary.' One important source of lessons learned information is the Occurrence Reporting and Processing System (ORPS) database, which contains event data from September 1, 1990, to the present. This report discusses this source. DOE

N93-22499# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
SEARCHING THE OCCURRENCE REPORTING AND PROCESSING SYSTEMS (ORPS) DATABASE
S. L. Commander Nov. 1992 11 p Presented at the 16th Training Resources and Data Exchange: Managing for Performance and Results, Seattle, WA, 2-4 Nov. 1992
(Contract DE-AC07-76ID-01570)
(DE93-005242; EGG-M-92365; CONF-921187-4) Avail: CASI HC A03/MF A01

The Occurrence Reporting and Processing System (ORPS) is a computerized method to submit, collect, update, and sign occurrence reports required by US Department of Energy (DOE) Order 5000.3B, Occurrence Reporting and Processing of Operations Information. The basic reason for investigating and reporting the causes of occurrences is to enable the identification of corrective actions to prevent recurrence and, thereby, protect the health and safety of the public, the workers, and the environment. ORPS provides the DOE community with a readily accessible database that contains information about occurrences at DOE facilities, causes of those occurrences, and corrective actions. This information can, therefore, be used to identify and analyze trends in occurrences. The ORPS database resides on a host computer located at the Idaho National Engineering Laboratory (INEL) in Idaho Falls, Idaho. The database can be accessed from any DOE site via computer terminals or personal computers (PCs) that are set up to access ORPS. DOE

N93-22514# Sandia National Labs., Albuquerque, NM.
GROPE: A GENESIS/EXODUS DATABASE EXAMINATION PROGRAM
G. D. Sjaardema Dec. 1992 27 p
(Contract DE-AC04-76DP-00789)
(DE93-006963; SAND-92-2289) Avail: CASI HC A03/MF A01

GROPE is a program that examines the input to a finite element analysis (which is in the GENESIS database format) or the output from an analysis (in the EXODUS database format). GROPE allows the user to examine any value in the database. The display can be directed to the user's terminal or to a print file. DOE

N93-22723# Pacific Northwest Lab., Richland, WA.
BEYOND INTERLIBRARY LOAN STATE-OF-THE-ART ARTICLE RETRIEVAL
E. L. Edwards Oct. 1992 6 p Presented at the Infotech 1992, Oak Ridge, TN, 21-23 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004425; PNL-SA-21344; CONF-9210158-4) Avail: CASI HC A02/MF A01

At the Hanford Technical Library, high-tech methods are providing researchers and managers with better journal article delivery. New technologies include the ProQuest Business Periodicals OnDisc system, which stores images of journals on CD-ROM; optically scanned and faxed images from CURL UnCover2; and fax communications with a commercial document delivery service. Overall successes and small setbacks in implementing these services will show the possibilities of rapid article retrieval in the 1990s. DOE

N93-22914# Sandia National Labs., Albuquerque, NM.
GJOIN: A PROGRAM FOR MERGING TWO OR MORE GENESIS DATABASES
G. D. Sjaardema Dec. 1992 35 p
(Contract DE-AC04-76DP-00789)
(DE93-007709; SAND-92-2290) Avail: CASI HC A03/MF A01

GJOIN is a two- or three-dimensional mesh combination program. GJOIN combines two or more meshes written in the GENESIS mesh database format into a single GENESIS mesh. Selected nodes in the two meshes that are closer than a specified distance can be combined. The geometry of the mesh databases can be modified by scaling, offsetting, revolving, and mirroring. The combined meshes can be further modified by deleting, renaming, or combining material blocks, sideset identifications, or nodeset identifications. GJOIN is one of the mesh generation tools in the Sandia National Laboratories Engineering Analysis Code Access System (SEACAS). GJOIN is typically used with the other SEACAS mesh generation codes GEN3D, GENSHELL, GREPOS, and Aprepro. DOE

N93-23002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNICAL REPORT WRITING
Carol A. Vidoli 1992 28 p
(NASA-TM-105419; E-6832; NAS 1.15:105419) Avail: CASI HC A03/MF A01

This manual covers the fundamentals of organizing, writing, and reviewing NASA technical reports. It was written to improve the writing skills of LeRC technical authors and the overall quality of their reports. Author

N93-23030*# National Aeronautics and Space Administration, Washington, DC.
NATIONAL SECURITY AND NATIONAL COMPETITIVENESS: OPEN SOURCE SOLUTIONS NASA REQUIREMENTS AND CAPABILITIES
Gladys A. Cotter Mar. 1993 11 p
(NASA-TM-4458; NAS 1.15:4458) Avail: CASI HC A03/MF A01

Foreign competitors are challenging the world leadership of the U.S. aerospace industry, and increasingly tight budgets everywhere make international cooperation in aerospace science necessary. The NASA STI Program has as part of its mission to support NASA R&D, and to that end has developed a knowledge base of aerospace-related information known as the NASA Aerospace Database. The NASA STI Program is already involved in international cooperation with NATA/AGARD/TIP, CENDI, ICSU/ICSTI, and the U.S. Japan Committee on STI. With the new more open political climate, the perceived dearth of foreign information in the NASA Aerospace Database, and the development of the ESA database and DELURA, the German databases, the NASA STI Program is responding by sponsoring workshops on foreign acquisitions and by increasing its cooperation with international partners and with other U.S. agencies. The STI Program looks to the future of improved database access through networking and a GUI; new media; optical disk, video, and full text; and a Technology Focus Group that will keep the NASA STI Program current with technology. Author

N93-23031*# Research Inst. for Computing and Information Systems, Houston, TX.
KNOWLEDGE BASE METHODOLOGY: METHODOLOGY FOR FIRST ENGINEERING SCRIPT LANGUAGE (ESL) KNOWLEDGE BASE Draft Interim Report, 1 Jun. - 1 Dec. 1992
Kumar Peeris (Barrios Technology, Inc., Houston, TX.) and Michel E. Izygon (Barrios Technology, Inc., Houston, TX.) 31 Dec. 1992 48 p
(Contract NCC9-16; RICIS Proj. SR-02)
(NASA-CR-192820; NAS 1.26:192820) Avail: CASI HC A03/MF A01

The primary goal of reusing software components is that software can be developed faster, cheaper and with higher quality. Though, reuse is not automatic and can not just happen. It has to be carefully engineered. For example a component needs to be easily understandable in order to be reused, and it has also to be malleable enough to fit into different applications. In fact the software development process is deeply affected when reuse is being applied. During component development, a serious effort has to be directed toward making these components as reusable. This implies defining reuse coding style guidelines and applying then to any new component to create as well as to any old component to modify. These guidelines should point out the favorable reuse features and may

apply to naming conventions, module size and cohesion, internal documentation, etc. During application development, effort is shifted from writing new code toward finding and eventually modifying existing pieces of code, then assembling them together. We see here that reuse is not free, and therefore has to be carefully managed. Author

N93-23127 Arkansas Univ., Fayetteville.
EVALUATING THE POTENTIAL OF COMBINING AN EXPERT SYSTEM AND SIMULATION FOR LAN SELECTION Ph.D. Thesis
Peggy Lea McDoniel Luster 1992 181 p
Avail: Univ. Microfilms Order No. DA9237324

Local Area Networks (LANs) made their debut in the office and today are an essential tool for users in business, government, and universities. While non-intelligent terminals remain a viable technology, most organizations are moving toward the LAN connected PC as the network of choice. As mission critical mainframe/minicomputer applications are downsized to LANs, LAN design and performance takes on greater importance, and an enhanced approach for LAN design would be valuable. Enhancing the performance of a LAN involves the analysis of a wide range of technical and user factors. Human experts in the field are scarce; alternative approaches to designing LANs are needed. One suggestion has been to use an expert system--a form of artificial intelligence (AI). A taxonomy exists for another suggested approach--combining an expert system with simulation. The cooperative approach is one possible combination in which an expert system and simulation can be used together to perform one task. The synergistic application of the technologies of AI and simulation to a given problem may lead to a much better solution with a higher chance of use than would the application of either one of the technologies by itself. The objective of this research is to develop and evaluate the synergistic approach of combining an expert system and simulation for LAN selection. To evaluate the effectiveness, LANs were designed using scenarios by human experts, human experts with the assistance of a simulation model, an expert system, and an expert system coupled with a simulation model. The LAN designs were simulated repetitively to produce user response times. To determine the effectiveness of the different approaches, response times were compared using non-parametric statistics. LAN response time results indicate that the expert system and combination system constructed in this study are valid systems and are viable methods to use in designing LANs. This study has shown that alternative approaches to human experts do exist. Based on the results, those not expert in LAN design can use either the expert system of the cooperative combination to produce LAN designs of quality comparable to those designed by human experts. Author (revised)

N93-23172*# National Aeronautics and Space Administration, Washington, DC.
INDEX TO NASA NEWS RELEASES AND SPEECHES, 1992
Feb. 1993 88 p
(NASA-TM-109187; NAS 1.15:109187) Avail: CASI HC A05/MF A01

This issue of the Index to NASA News Releases and Speeches contains a listing of news releases distributed by the Office of Public Affairs, NASA Headquarters, and a selected listing of speeches presented by members of the Headquarters staff during 1992. The index is arranged in six sections: subject index, personal names index, news release number index, accession number index, speeches, and news releases. Derived from text

N93-23183 Texas A&M Univ., College Station.
AEROBA: A CONTROL BLACKBOARD APPROACH FOR MODEL FORMULATION Ph.D. Thesis
Shue-Feng Tzeng Liou 1992 323 p
Avail: Univ. Microfilms Order No. DA9232535

During a model formulation process, the control is used to dynamically apply various strategies to the appropriate sources of knowledge for the proper parts of problem. The importance of the control aspect has been emphasized in the literature. However, previous studies in automated model formulation use various AI techniques with pre-defined control strategies and can not provide enough support for simulating the expert's modeling process. In order to develop a computerized system based on the expert's model formulation process, a set of verbalization protocols was collected from the experts in managerial domains. The analysis provides two major findings, opportunism and control features. In terms of opportunism, the expert is understood as using various cognitive panels and frequently changing the focus of attention during the formulation process. During this process, the expert also uses various control features for directing the formulation progress. The protocol analysis provides key inputs to the design of the implementation architecture, AEROBA. Due to the opportunism observed from the expert's protocols, the blackboard architecture is selected for the AEROBA design, In this blackboard architecture, an EER model (Extended Entity Relationship model) is used to define the blackboard data structure, a structure transformation approach based on the EER constructs is used to design the domain knowledge, and finally, a control blackboard approach is used to design the control. The AEROBA control simulates the control aspect observed from the protocol analysis. With the incorporation of the control features, AEROBA supports a diverse reasoning process and hence extends the flexibility of control in automated model formulation. The prototype of the AEROBA system is implemented in Common LISP on a SUN 3/160 workstation. The evaluation of the AEROBA system involves two approaches: validation and verification. Validation is used to check the correctness of the formulations outcomes and the formulation process of the system. Verification is used to determine the usefulness, called the formulation effectiveness, of the system. The evaluation indicates that the AEROBA approach is an appropriate way to realize the abstract control aspect in model formulation into a computerized environment. Dissert. Abstr.

N93-23184 Indiana Univ., Bloomington.
THE NATURE OF RELEVANCE IN INFORMATION RETRIEVAL: AN EMPIRICAL STUDY Ph.D. Thesis
Taemin Kim Park 1992 209 p
Avail: Univ. Microfilms Order No. DA9231644

This research is concerned with end users' evaluative attitudes and behaviors in accepting or rejecting citations from a document retrieval system - the concept of 'relevance.' In spite of a rich literature about the meaning of relevance in information science, a consensus meaning has not yet been found. The nature of relevance has not been investigated from the end users' point of view and an empirical study concerning the users' concept of relevance does not exist. Relevance and relevance judgments play a key role in the evaluation of the performance of a document retrieval system and are central to doing experimental information retrieval (IR) research in particular. They have been employed as a standard criterion for measuring the effectiveness of an information system and have been a subject of heated debate from a methodological point of view. As a result, relevance and relevance judgements have become stumbling blocks for interpreting the results of IR experimental research as well as advancing IR theory. Using a naturalistic inquiry methodology, the present research is an empirical study of users' relevance interpretations. A model of a user's relevance interpretation is presented, which reflects the nature of the thought process of a user in evaluating bibliographic citations produced by a document retrieval system. Three major categories of interpretative criteria - internal context, external context and problem context - are identified and described. Users' relevance assessments involve several layers of interpretation that are derived from their experience, perceptions and private knowledge related to the particular information problem at hand. Dissert. Abstr.

N93-23185 Universitaire Instelling Antwerpen, Wilrijk (Belgium).
CONCENTRATION AND DIVERSITY IN INFORMETRIC RESEARCH Ph.D. Thesis [CONCENTRATIE EN DIVERSITEIT IN INFORMETRISCH ONDERZOEK]
Ronald Rousseau 1992 268 p In BELORUSSIAN
Avail: Univ. Microfilms Order No. DA9234353

The purpose of this thesis is to make a study of functions being used to measure concentration and diversity. As a means to differentiate among functions presented in literature the axiomatic method is used, the Lorenz curve playing a significant part as well. First, the case is studied in which a number of items is distributed over a fixed number of sources. According to the distribution this leads to situations with different concentrations. By imposing more or less restricting requirements on functions a first classification of measures (type 1, type 2 and type 3) can be achieved for a fixed number of sources. The well-known Gini index e.g. is a concentration measure of type 2, the coefficient of variation is a concentration measure of type 3, and Shannon's index a diversity measure of type 1. In this classification a measure of a particular type is automatically a measure of a type with a smaller number as well. Next, the interesting problem is studied where situations with a different number of sources are compared

as for concentration or diversity. A number of new measures is proposed, inferred from a shifted version of the Lorenz curve. In the final chapter it is specified how to use these measures in informetrics: e.g. in the study of the evolution of bibliographies or in determining a set of core journals. Dissert. Abstr.

N93-23228# National Inst. of Standards and Technology, Gaithersburg, MD. Computer Security Div.

ASSESSING FEDERAL AND COMMERCIAL INFORMATION SECURITY NEEDS

David F. Ferraiolo, Dennis M. Gilbert, and Nickllyn Lynch Nov. 1992 45 p

(PB93-138956; NISTIR-4976) Avail: CASI HC A03/MF A01

The study assesses the current and future information technology (IT) security needs of the commercial, civil, and military sectors. The primary objectives were as follows: determine a basic set of information protection policies and control objectives that pertain to the secure processing needs of organizations within all sectors; and identify protection requirements and technical approaches that are used, desired, or sought so they can be considered for future federal standards and guidelines. The findings of the study address the basic security needs of IT product users, including system developers, end users, administrators, and evaluators. Security needs have been identified based on actual existing and well-understood security organizational practices. GRA

N93-23256# Geological Survey, Reston, VA.

US GEOLOGICAL SURVEY LIBRARY CLASSIFICATION SYSTEM

R. Scott Sasscer 1992 82 p

(PB93-129708; USGS-Bull-2010; LC-91-39984) Avail: CASI HC A05/MF A01

The U.S. Geological survey library classification system has been designed for an earth science library. It is a tool, assigning classification numbers to earth science and allied pure science library materials in order to collect these materials into related subject groups on the library shelves and arrange them alphabetically by author and title. It can also be used as a retrieval system to assess these materials through the subject and visible geographic classification numbers. The purpose of the publication is to provide the earth science community with a classification and retrieval system for earth science materials, to provide sufficient explanation of its structure and use, and to enable library staff and clientele to classify or access research materials in a library collection. Author

N93-23272# National Inst. of Standards and Technology, Gaithersburg, MD. Advanced Systems Div.

EFFECTIVENESS OF FEATURE AND CLASSIFIER ALGORITHMS IN CHARACTER RECOGNITION SYSTEMS

C. L. Wilson Dec. 1992 16 p

(PB93-147197; NISTIR-4995) Avail: CASI HC A03/MF A01

At the first Census Optical Character Recognition (OCR) Systems Conference, NIST generated accuracy data for more than 40 character recognition systems. Most systems were tested on the recognition of isolated digits and upper and lower case alphabetic characters. The recognition experiments were performed on sample sizes of 58,000 digits, and 12,000 upper and lower case alphabetic characters. The algorithms used by the 26 conference participants included rule-based methods, image-based methods, statistical methods, and neural networks. The neural network methods included Multi-Layer Perceptrons, Learned Vector Quantitization, Neocognitrons, and cascaded neural networks. In this paper, 11 different systems are compared using correlations between the answers of different systems, comparing the decrease in error rate as a function of confidence of recognition. This comparison shows that methods that used different algorithms for feature extraction and recognition performed with very high levels of correlation. This is true for neural network systems, hybrid systems, and statistically based systems, and leads to the conclusion that neural networks have not yet demonstrated a clear superiority to more conventional statistical methods. GRA

N93-23279# National Library of Medicine, Bethesda, MD. Bibliographic Services Div.

MEDICAL SUBJECT HEADINGS: SUPPLEMENTARY CHEMICAL RECORDS, 1993 Final Report, 1970-1992

Dec. 1992 1260 p

(PB93-115244; NLM/MED-93/04) Avail: CASI HC A99/MF A10

The document contains records of approximately 22,000 chemicals which since 1970 have been mentioned in a significant way in journals indexed in MEDLINE, the National Library of Medicine's online bibliographic database. Originally housed in a manual card file, these records were incorporated as a subset of the MEDLARS MeSH (Medical Subject Headings) file, and became searchable online in June 1980. The present list does not include any of the chemical descriptors that are to be found in the D Category of MeSH. The publication is intended to assist indexers, and the users of Index Medicus and MEDLINE. For the indexer, it provides more specific entries than those available in the printed MeSH. It permits users of Index Medicus to locate the chemical subject headings under which citations referring to a more specific chemical can be found. GRA

N93-23285# National Center for Health Statistics, Hyattsville, MD. Div. of Analysis.

PUBLIC LIBRARIES IN THE US, 1990

Jan. 1992 179 p

(PB93-127926; NCES-92-028; ISBN-0-16-037950-4) Avail: CASI HC A09/MF A02; SOD HC

The E.D. TABS presents FY90 state and national data aggregated from individual public libraries in the United States. The E.D. TABS includes information about staffing, service outlets, operating income and expenditures, size of collection, and service measures such as reference transactions, interlibrary loans, circulation, and public service hours. Although individual public library data were not included in the E.D. TABS, they will soon be available on diskette. The tables in the E.D. TABS summarize information about public libraries in FY90. The information was supplied to the National Center of Education Statistics (NCES) by state library agencies in machine-readable format through the Federal State Cooperative System (FSCS). GRA

N93-23370# Rolls-Royce Ltd., Derby (England). Materials and Mechanical Research Group.

ENGINEERING DATA INTEGRATION: PROBLEMS AND SOLUTIONS

Roger Bamkin 10 Dec. 1990 15 p Presented at Engineering Applications Support Environment EASE Education and Awareness Programme Seminar, Loughborough Univ. of Technology, England, 7 Nov. 1990

(PNR-90999; ETN-93-93481) Copyright Avail: CASI HC A03/MF A01

A set of overhead projector graphics used to present data exchange, data storage and related problems concerning information on materials, is presented. A comment on the Engineering Application Support Environment seminar in general is given. The modular and layered design of an information system is discussed. CALS (Computer Aided Logisitic Support) is addressed. One of the many possible inheritance structures for material classes is structured. ESA

N93-23378# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.

MEAN LEVELS IN NONLINEAR ANALYSIS AND IDENTIFICATION

J. C. PeytonJones (Sussex Univ., Brighton, England.) and S. A. Billings 11 Jun. 1992 24 p

(RR-454; ETN-93-93494) Copyright Avail: CASI HC A03/MF A01

The effects of data pretreatment and mean levels upon nonlinear model structures is investigated. Techniques which are commonly used to prefilter data in linear system identification are shown to alter the model structure in the nonlinear case. The effects of mean levels are considered in detail and an unraveling algorithm is derived to recover the underlying system model when the offsets are external to the system. A mapping from the time domain to the frequency domain is introduced for the case where offsets can be considered as an implicit part of the system. ESA

N93-23381 Texas Univ., Austin.

ACCESS METHODS FOR LARGE, MULTIFUNCTIONAL KNOWLEDGE BASES Ph.D. Thesis

Liane Elizabeth Hayn Acker 1992 243 p

Avail: Univ. Microfilms Order No. DA9239205

The goal of this research is to develop methods for representing and accessing knowledge to support multiple tasks. The goals of the research are threefold. The first goal is to develop an expressive and convenient frame-based language for representing domain knowledge so that it can

be applied to multiple tasks. A single comprehensive, fine grained representation of domain knowledge that can support a variety of applications is more flexible and cost-effective than several special-purpose knowledge bases. The second goal of the research is to make users of a knowledge base less dependent on the particulars of how knowledge is represented. This is achieved by providing a content addressable knowledge base and by providing access to concepts in the virtual knowledge base. Users can access frames in the knowledge base by description as well as by name, regardless of whether they exist explicitly or implicitly in the knowledge base. The third goal of the research is to develop computational methods for accessing from a knowledge base coherent portions of knowledge about a given concept (called viewpoints of concepts). Viewpoints are essential for a variety of tasks, including explanation generation, compositional modeling, problem solving, and machine learning. This research identifies several types of viewpoints and develops methods for constructing viewpoints of each type. Evaluation suggests that the viewpoints generated by these methods are comparable in coherence to human-generated viewpoints. Dissert. Abstr.

N93-23382 Miami Univ., Coral Gables, FL.
AN OBJECT-ORIENTED DATABASE APPROACH TO THE STORAGE AND USE OF MEDICAL DATA Ph.D. Thesis
Raymond David Frost 1992 257 p
Avail: Univ. Microfilms Order No. DA9239656

An object oriented database was constructed in order to aid in the diagnosis and treatment of patients with aphasia. A relational database was also constructed for comparison purposes. The two models were compared on several dimensions in order to illustrate the advantages available in the object oriented implementation. These advantages include support for embedded procedures, inheritance, complex objects and abstract data types. The object oriented implementation was also shown to provide greater data integrity brought about by a tighter coupling of data and procedures. The system chosen for the object oriented implementation was the Postgres Next Generation Database Management System. An argument was made for the adoption of an object oriented database management system for further research on computerization of the medical record. Dissert. Abstr.

N93-23383 Toronto Univ. (Ontario).
PERFORMANCE PREDICTION OF RELATIONAL DATABASE MANAGEMENT SYSTEMS Ph.D. Thesis
William Francis Hyslop 1991 265 p
(ISBN-0-315-69232-4) Avail: Univ. Microfilms Order No. DANN69232

Although relational data base management systems are widely used in commercial applications, the performance of these systems is not yet fully understood. It is the intent of this thesis to develop a comprehensive analytical model of relational database systems capable of predicting their performance. MOSES, a multi-layered model will provide a means of quantitative evaluation of design decisions at various levels within the database design process. Also the interdependencies of design decisions may be studied. As a basis, the model integrates the best concepts from existing performance prediction models. The model is then extended to account for some important factors not included in prior models. These additions to the model include the effects of locking, recovery activities, the relational optimizer and executing transactions on diverse hardware architectures. An easy to use, menu-driven prototype tool, called JOSHUA, is developed which implements the proposed model and provides a means for validating the model. The predictions of the model are compared against observations obtained from operational database environments, including both a traditional mainframe DBMS and a multi-micro database machine. Dissert. Abstr.

N93-23412*# National Aeronautics and Space Administration, Washington, DC.
COORDINATING COUNCIL. FIRST MEETING: NASA/RECON DATABASE
23 May 1990 3 p Meeting held in Washington, DC, 23 May 1990
(NASA-TM-108766; NAS 1.15:108766) Avail: CASI HC A01/MF A01

A Council of NASA Headquarters, American Institute of Aeronautics and Astronautics (AIAA), and the NASA Scientific and Technical Information (STI) Facility management met (1) to review and discuss issues of NASA concern, and (2) to promote new and better ways to collect and disseminate scientific and technical information. Topics mentioned for study and discussion at subsequent meetings included the pros and cons of transferring the NASA/RECON database to the commercial sector, the quality of the database, and developing ways to increase foreign acquisitions. The input systems at AIAA and the STI Facility were described. Also discussed were the proposed RECON II retrieval system, the transmittal of document orders received by the Facility and sent to AIAA, and the handling of multimedia input by the Departments of Defense and Commerce. A second meeting was scheduled for six weeks later to discuss database quality and international foreign input. CASI

N93-23424# Technical Research Centre of Finland, Otaniemi.
ANNUAL BIBLIOGRAPHY, 1989 [TEKNILLINEN KORKEAKOULU VUOSIBIBLIOGRAFIA 1989]
1990 157 p In ENGLISH and FINNISH
(ISBN-951-22-0488-6; ETN-93-93690) Avail: CASI HC A08/MF A02

The publications by departments and institutes at the Helsinki University of Technology in 1989 are listed as part of the annual report. The authors themselves are responsible for the bibliographical data of the publications. The material is arranged under facilities, departments, and institutes. The bibliography also includes an index by author and keyword. ESA

N93-23462# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
COMPARISON OF FOUR-CURSOR BUTTONS VERSUS JOYSTICK TO ACCESS COMPUTERIZED TECHNICAL INFORMATION FROM AN INTEGRATED MAINTENANCE INFORMATION SYSTEM M.S. Thesis
Gerald E. Streff and Robert H. Gundel Sep. 1992 119 p
(AD-A259967; AFIT/GLM/LSY-92S-20) Avail: CASI HC A06/MF A02

The purpose of this thesis was to evaluate the use of four-cursor buttons versus a joystick device to present technical order information on a portable maintenance aid computer for aircraft technicians in a maintenance environment. Studies to date have verified the superiority of computer-presented technical orders when compared to current paper-based systems; this research investigated the effectiveness of these computer-based systems when technicians used a joystick or four-cursor button to display desired technical information. A comparison was made as to technician performance using a portable maintenance aid at the 4950th Test Wing, WPAFB OH. A total of thirty-two maintenance technicians accessed and displayed technical information using a joystick device and the four-cursor keys. Results indicated no statistically significant difference in the performance of maintenance technicians when using either access device in a controlled environment. The major conclusion was that either access device may be a viable answer for use in the flight line environment. The chief recommendation is that further studies be performed using a different joystick device and computer software that supports the eight joystick functions. GRA

N93-23488 Arizona State Univ., Tempe.
CONDITION MONITORING IN AN ACTIVE DEDUCTIVE DATABASE Ph.D. Thesis
John Vincent Harrison 1992 219 p
Avail: Univ. Microfilms Order No. DA9237260

An 'active' database management system (DBMS) is characterized by its ability to automatically monitor user-defined conditions and react when the conditions become satisfied. In a conventional DBMS, queries and transactions are executed only when explicitly requested by a user or application program. Certain applications, such as those that require timely responses to changes in the database state, are not well served by a traditional, passive DBMS. Conditions identify database states, or state transitions, that are of interest to the user. The use of a logical language to represent these conditions increases the sophistication of an active database since it allows for more expressive conditions, which can represent a larger scope of real-world situations. This dissertation presents a condition monitor for conditions expressed using safe, recursive Datalog with stratified negation. Initially, an approach to condition monitoring that is based on incremental change theory, which was developed for the HiPAC active database system, is corrected and applied to this problem. Next, a more powerful approach, termed Propagation/Filtration (PF), is developed that is based on update propagation. An enhanced recursive query evaluation strategy based on both resolution, and memoing, is developed for use with the PF algorithm. The enhancement exploits mutually recursive

equivalence classes when negation is present. A prototype of the condition monitor is implemented to demonstrate its ability to monitor conditions defined in terms of linear and non-linear recursion. Optimizations are given that eliminate redundant and irrelevant computation. These optimizations utilize memoing, sideways-information-passing, strategies, multiple query optimization, partial evaluation and select program characteristics. Each optimization is implemented in the prototype to demonstrate the performance increase achieved. Active services include alerters, triggers and integrity constraints. These services can be used to elegantly support a variety of other database functions including materialized view maintenance and database security. The condition monitor described in this dissertation provides support for active services in a deductive database and represents a practical application of deductive database technology. Dissert. Abstr.

N93-23503 Texas Univ., Austin.
PARALLEL EVALUATION OF DEDUCTIVE DATABASE QUERIES Ph.D. Thesis
Sumit Ganguly 1992 185 p
Avail: Univ. Microfilms Order No. DA9239257

In this dissertation, we are concerned with the parallel bottom-up evaluation of a subset of deductive database languages called Datalog. We present a family of parametric parallelization strategies for Datalog programs. Several algorithms that were independently proposed for the parallel computation of specific Datalog programs can be obtained by properly choosing the parameters. The choice of the parallelization parameters significantly influences some properties of the resulting parallel executions, such as interprocess communication and fragmentation of the database. We present an algorithm to determine the minimal logical connectivity of the communicating processors, given a choice of the parallelization parameters. We also investigate the converse of the above question; namely, given a Datalog program and a network of processors, is it possible to choose the parallelization parameters such that the resulting parallel execution can be mapped onto the network of processors? This question is similar in nature to the question of mapping numerical algorithms to a systolic array of processors. However, unlike numerical algorithms, Datalog programs display very little structure; for example, there is no notion of a loop index or an array index. It is therefore somewhat surprising that this question can be decided algorithmically for a very large class of Datalog programs. Given a particular database system, it is an interesting question to choose the parallel execution which results in minimum response time. Unfortunately, accurate cost models estimating the computational cost of recursive Datalog programs is not available. Hence, optimizing for the parallel execution of recursive Datalog programs is difficult. We thus restrict our attention to the problem of optimizing non-recursive Datalog programs for parallel executions. Our contributions to this problem domain are: (1) Presentation of a clear execution space and cost model that models data dependency, independent parallelism and pipelined parallelism. (2) The observation that dynamic programming search strategies need to be executed to use partial order; that is, plans must be compared simultaneously along different dimensions. We show how such metrics may be designed within our model. (3) An initial investigation into modeling resource usage on two different architecture. We propose that inherent symmetry of systems should be used to decrease the dimensions of the search. Dissert. Abstr.

N93-23646# Department of the Treasury, Washington, DC. Office of the Deputy Assistant Secretary for Information Systems.
EXECUTIVE SUMMARY OF INFORMATION SYSTEMS PLANS: FISCAL YEARS 1994 TO 1998
Dec. 1992 110 p
(PB93-146330) Avail: CASI HC A06/MF A02

The report is an overview of the major information systems that the Department of Treasury expects to implement and maintain during the next five years. The summary provides Treasury Bureaus, federal officials, and the public with information on strategic planning issues for the department. In addition, the document summarizes plans for the development and implementation of information systems that have not only departmental importance but national significance as well. In particular, three of the Treasury's major systems include ones designated by OMB as part of its Program for Priority Systems; these systems are the Internal Revenue Service's Tax Systems Modernization, the Financial Management Service's System 90, and the U.S. Customs Service's Interagency Border Inspection System. GRA

N93-23869# National Inst. of Standards and Technology, Gaithersburg, MD.
DATABASE MANAGEMENT SYSTEMS IN ENGINEERING
Katherine C. Morris, Mary Mitchell, Christopher Dabrowski, and Elizabeth Fong Dec. 1992 56 p
(PB93-138964; NISTIR-4987) Avail: CASI HC A04/MF A01

Until recently the applicability of database technology to engineering systems has been limited. Early database systems addressed large-scale data processing needs of easily automatable applications. These applications were characterized by very uniform data and well understood processing methods. Engineering applications on the other hand, are characterized by highly complex data with very variable structure. The need to represent engineering data has driven advances in database technology. Engineering domains also impose unique, new requirements on other aspects of database technology. In particular, to support the evolutionary nature of the engineering environment, recent developments in database technology have focused on the temporal dimensions of data management. In addition, the present trend in manufacturing towards concurrent engineering raises new considerations for the cooperative use of data in a distributed engineering environment. All of these factors are reflected in the new generation of database systems and are described in the article. GRA

N93-24094 University of North Texas, Denton.
THE IMPACT OF COMPUTER INSTRUCTION ON THE NEAR TRANSFER AND FAR TRANSFER OF A GENERAL PROBLEM-SOLVING STRATEGY Ph.D. Thesis
Beverly Gene Abbey 1992 95 p
Avail: Univ. Microfilms Order No. DA9300577

Hypotheses related to the transfer of a general problem solving strategy were tested in this study. A modified Solomon Four-Group design was used to control for threats to internal validity and to consider external validity factors. One-half of each of three intact groups of university students were given the Means-Ends Problem Solving pretest. Two of the groups received instruction on a means-ends problem solving strategy using Lemmings, a commercial game/simulation. One treatment group was instructed on the computer; one group was instructed by a classroom teacher. Near transfer was assessed 1 week later using additional levels of increasing difficulty from Lemmings. The computer group was presented the transfer tasks on the computer; the classroom group was presented paper-and-pencil tasks using screen prints from Lemmings. One week after the near transfer tasks, far transfer was assessed using an alternate portion of the Means-Ends Problem Solving procedure. Results indicated a significant difference in relevancy gain scores on the far transfer posttest between the treatment groups and the control group (p less than .0001). No significant difference was found in far transfer relevancy scores between the two treatment groups. No significant difference was found in the near transfer relevancy scores between the treatment groups, but there was a significant difference in the number of correct solutions (P less than .05). The classroom instructed group successfully solved more levels. It appears that the ability to transfer a general problem solving heuristic within a domain and across domains can be profoundly improved. A computer can be effectively used to improve transfer across domains. Dissert. Abstr.

N93-24110# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
KNOWLEDGE-BASED SYSTEMS FOR COMPUTATIONAL CONTROL Final Report, 1 Jul. 1989 - 30 Jun. 1992
Robert F. Stengel Nov. 1992 12 p
(Contract DAAL03-89-K-0092)
(AD-A260409; MAE-1963; ARO-25264.23-MA) Avail: CASI HC A03/MF A01

New tools for control system design were created and 'pathfinders' for implementing new design principles in operational control systems were established. Four topics were addressed in the subject project: neural networks for system modeling and nonlinear control; stochastic robustness of control systems; computer-aided control system design; and optimal rule-based guidance for autonomous vehicles. The principal result of the first task is the development of a new method for training neural networks using extended Kalman filtering to match not only multivariate functions but the gradients of their surfaces. The principal result of the second task is the development of a powerful new method for characterizing the robustness of control systems and for designing controllers with satisfactory

stability and performance robustness. The principal result of the third task is the identification of a new computational structure for multidisciplinary control system design. The principal result of the fourth task is a new approach for designing real-time rule-based controllers that can operate in uncertain environments, with particular application to the guidance of vehicles on a roadway with traffic. GRA

N93-24113# Naval Postgraduate School, Monterey, CA.
INTELLIGENT INFORMATION RETRIEVAL FOR A MULTIMEDIA DATABASE USING CAPTIONS Ph.D. Thesis
Eugene J. Guglielmo 23 Jul. 1992 370 p
(AD-A260438) Avail: CASI HC A16/MF A03

An intelligent information retrieval system, MARIE, that employs natural language processing techniques for indexing and retrieving multimedia data is described. Captions describe photographs from the Naval Air Warfare Center Weapons Division, China Lake, California; the captions were written in English consisting mostly of noun phrases. For our work, an object-oriented type hierarchy represents semantic knowledge. Captions are parsed to produce a logical form, from which nouns and verbs are extracted to form keyword files. User queries are also specified in natural language. A two-phase match process is employed between the query and database. A coarse-grain match searches the keyword files and issues SQL queries to a relational database as necessary to find candidate captions for further analysis. A fine-grain match then compares the logical form of the query to the logical form for each caption. A list of caption ID's and accompanying match scores is then presented to the user, who can view the image and supporting data. A companion technical report contains the programs for the system discussed here. GRA

N93-24117*# National Aeronautics and Space Administration, Washington, DC.
MODERNIZATION AND UNIFICATION: STRATEGIC GOALS FOR NASA STI PROGRAM
W. Blados and G. Cotter Apr. 1993 16 p
(NASA-TM-109186; NAS 1.26:109186) Avail: CASI HC A03/MF A01

Information is increasingly becoming a strategic resource in all societies and economies. The NASA Scientific and Technical Information (STI) Program has initiated a modernization program to address the strategic importance and changing characteristics of information. This modernization effort applies new technology to current processes to provide near-term benefits to the user. At the same time, we are developing a long-term modernization strategy designed to transition the program to a multimedia, global 'library without walls.' Notwithstanding this modernization program, it is recognized that no one information center can hope to collect all the relevant data. We see information and information systems changing and becoming more international in scope. We are finding that many nations are expending resources on national systems which duplicate each other. At the same time that this duplication exists, many useful sources of aerospace information are not being collected because of resource limitations. If nations cooperate to develop an international aerospace information system, resources can be used efficiently to cover expanded sources of information. We must consider forming a coalition to collect and provide access to disparate, multidisciplinary sources of information, and to develop standardized tools for documenting and manipulating this data and information. In view of recent technological developments in information science and technology, as well as the reality of scarce resources in all nations, it is time to explore the mutually beneficial possibilities offered by cooperation and international resource sharing. International resources need to be mobilized in a coordinated manner to move us towards this goal. This paper reviews the NASA modernization program and raises for consideration new possibilities for unification of the various aerospace database efforts toward a cooperative international aerospace database initiative that can optimize the cost/benefit equation for all participants. Author

N93-24186 Stanford Univ., CA.
ARCHITECTURE FOR HUMAN-COMPUTER DESIGN, MANAGEMENT AND COORDINATION IN A COLLABORATIVE AEC ENVIRONMENT Ph.D. Thesis
Hossam El-Din El-Bibany 1992 125 p
Avail: Univ. Microfilms Order No. DA9234092

A collaborative information system must fit the market, the organization, the culture, and the norms of the group it supports. In the Architecture/Engineering/Construction (AEC) industry, a computer-based framework for collaboration needs to consider issues such as its application suitability in various project organizations, and the ability to operate under partial knowledge. A formal Collaborative Knowledge-integration Systems (CKiS) methodology for integrating multidisciplinary knowledge, and building and managing the dynamic data-dependency structures based on the integrated knowledge is described. The methodology forms the core of an AEC collaboration framework and the corresponding computer system architecture. The architecture facilitates integrated design and project management in a flexible methodology that accommodates the various tasks required to create the product (facility) under a unified representation and inference. The unified methodology serves as the basis for interdisciplinary knowledge integration. On the project data level, the integrated knowledge forms and maintains dynamic data-dependency structures that react to and update with changes in data items in any direction. The data-dependency structures represent the causal relationships among data items and have the ability to handle unanticipated situations, provide a formal way to construct and maintain the knowledge (and data) base, and provide a universal medium for understanding (through causal explanation) the functioning of a system. The human-computer architecture builds on constraint-management techniques. Low-level parametric models represent the structure and behavior of, and the relationship between, various project entities in a standard representational model. The architecture handles parametric as well as boolean constraints in a standard integrated representation and inference mechanism. A sophisticated constraint-management methodology coupled with interval-based mathematics is the basis for domain modeling, models' integration, and the quantitative and qualitative inference capabilities of the architecture. Elements of the architecture follow representation standards. Based on these standards, the architecture may be considered as shell for both domain modeling and project design, management, and coordination. The shell may be employed in different domains under different organizational requirements. Dissert. Abstr.

N93-24196# Illinois Univ., Urbana. Center for Reliable and High-Performance Computing.
ASSIGNING SITES TO REDUNDANT CLUSTERS IN A DISTRIBUTED STORAGE SYSTEM
Antoine N. Mourad, W. K. Fuchs, and Daniel G. Saab 1992 23 p
(Contract N00014-91-J-1283)
(AD-A260458) Avail: CASI HC A03/MF A01

Redundant Arrays of Distributed Disks (RADD) can be used in a distributed computing system or database system to provide recovery in the presence of disk crashes and temporary and permanent failures of single sites. In this paper, we look at the problem of partitioning the sites of a distributed storage system into redundant arrays in such a way that the communication costs for maintaining the parity information are minimized. We show that the partitioning problem is NP-hard. We then propose and evaluate several heuristic algorithms for finding approximate solutions. Simulation results show that significant reduction in remote parity update costs can be achieved by optimizing the site partitioning scheme. GRA

N93-24202# National Agricultural Library, Beltsville, MD.
AGRICOLA SUBJECT CATEGORY CODES WITH SCOPE NOTES (MODIFIED AGRIS)
1990 181 p Revised
(PB93-152643) Avail: CASI HC A09/MF A02

The National Agricultural Library (NAL) classifies documents according to the AGRICOLA Subject Category Codes with Scope Notes (1990 revision). These codes are access points in NAL's AGRICOLA online database and are also used to format the data bases's print equivalent, The Bibliography of Agriculture. GRA

N93-24204# National Agricultural Library, Beltsville, MD.
LIST OF JOURNALS INDEXED IN AGRICOLA, 1992
Carol L. Dowling, ed. and Thor Lehnert, ed. Jan. 1992 215 p
(PB93-152650) Avail: CASI HC A10/MF A03

The Indexing Branch of the National Agricultural Library and its cooperators currently index 2,012 journals for AGRICOLA (Agricultural On Line Access), the Library's bibliographic database. AGRICOLA contains records for agricultural literature citations of journal articles, monographs,

theses, patents, software, audiovisual materials, and technical reports. Indexing records comprise approximately 85 percent of the AGRICOLA database, the remaining 15 percent being cataloging records. The List of Journals Indexed in AGRICOLA 1992 contains a new section for titles which have abstracts included in the AGRICOLA record. As in previous editions, a listing of journal titles that have been added for indexing in the past year and a listing of previously indexed titles that are no longer indexed are included. Also included are an alphabetized abbreviated title listing of journals indexed and a subject listing. In the subject listing, journals are categorized based on both the topic of the journal and the types of articles that are indexed for AGRICOLA. GRA

N93-24258# Rome Lab., Griffiss AFB, NY.
ADVANCED INFORMATION PROCESSING
John M. Pirog Oct. 1992 33 p
(AF Proj. 4594)
(AD-A260245; RL-TR-92-244) Avail: CASI HC A03/MF A01

Current text processing techniques fall short of required accuracies. Text retrieval and filtering techniques are still largely based on keywords. Several new techniques and their combinations can provide far greater accuracy in text retrieval and dissemination. Many of these techniques are briefly explored and their integration into the real world is also discussed. GRA

N93-24307# Executive Office of the President, Washington, DC. Office of Administration.
PUBLICATIONS OF THE EXECUTIVE OFFICE OF THE PRESIDENT, 20 JAN. 1989 - 20 JAN. 1993: REPORT TO THE CONGRESS
1993 17 p
(PB93-139764) Avail: CASI HC A03/MF A01

The report is the final list of Publications of the Executive Office of the President for the Bush Administration - January 20, 1989 - January 20, 1993. There is no guarantee that the list will continue to be published in the future. GRA

N93-24450# Lawrence Livermore National Lab., CA.
STORAGE SYSTEMS FOR NATIONAL INFORMATION ASSETS: A COLLABORATIVE RESEARCH PROJECT
Robert A. Coyne (IBM Federal Systems Div., Westlake Village, CA.), Harry Hulen (IBM Federal Systems Div., Owego, NY.), and Richard Watson Mar. 1992 16 p
(Contract W-7405-eng-48)
(DE93-007402; UCRL-ID-111559) Avail: CASI HC A03/MF A01

The grand challenge problems of science and industry that are driving computing and communications have created corresponding challenges in information storage and retrieval. An industry-led collaborative project has been organized to investigate technology for storage systems that will be the future repositories for our national information assets. Industry participants are IBM Federal Systems Company, Ampex Recording Systems Division, General Atomics DISCOS Division, IBM Storage Systems Products Division, Maximum Strategy Corporation, Network Systems Corporation, and Zitel Corporation. Industry members of the collaborative project are funding their own participation. Lawrence Livermore National Laboratory through its National Energy Research Supercomputer Center (NERSC) will participate in the project as the operational site and the provider of applications. The expected result is the creation of a National Storage Laboratory to serve as a prototype and demonstration facility. It is expected that this prototype will represent a significant advance in the technology for distributed storage systems capable of handling gigabit class files at gigabit per second data rates. Specifically, the collaboration expects to make significant advances in hardware, software, and systems technology in the four areas of need that are identified in this paper, which are (1) network-attached high performance storage; (2) multiple, dynamic, distributed storage hierarchies; (3) layered access to storage system services; and (4) storage system management. DOE

N93-24560# Environmental Protection Agency, Washington, DC. Office of the Assistant Administrator for Water.
PUBLICATIONS OFFICE OF SCIENCE AND TECHNOLOGY: CATALOG
Sep. 1992 107 p
(PB93-152577; EPA/820/B-92/002) Avail: CASI HC A06/MF A02

The catalog lists documents produced by the office of Science and Technology that are available from the Water Resource Center and the National Technical Information Service. Author

N93-24573# Department of Energy, Washington, DC.
WRITER'S GUIDE FOR TECHNICAL PROCEDURES
31 Dec. 1992 132 p
(DE93-007746; DOE-STD-1029-92) Avail: CASI HC A07/MF A02

This Writer's Guide for Technical Procedures is one of a series of documents currently being developed by the US Department of Energy (DOE) to define broad requirements for procedure program management and to provide guidance for the preparation of procedures used at DOE facilities. This preface describes the intent and overall approach of the DOE's procedures program and presents a brief overview of how this writer's guide fits into the series of procedures guidance documents currently under development. DOE

N93-24631# National Inst. of Standards and Technology, Gaithersburg, MD. Advanced Systems Div.
MACHINE-ASSISTED HUMAN CLASSIFICATION OF SEGMENTED CHARACTERS FOR OPTICAL CHARACTER RECOGNITION TESTING AND TRAINING
R. A. Wilkinson, M. D. Garris, and J. Geist Dec. 1992 14 p
(PB93-152155; NISTIR-5105) Avail: CASI HC A03/MF A01

The National Institute of Standards and Technology (NIST) needed a large set of segmented characters for use as a test set for the First Census Optical Character Recognition (OCR) Systems Conference. A machine assisted human classification system was developed to expedite the process. The testing set consists of 58,000 digits and 10,000 upper and lower case characters entered on forms by high school students and is distributed as Testdata 1. A machine system was able to recognize a majority of the characters but all system decisions required human verification. The NIST recognition system was augmented with human verification to produce the testing database. The augmented system consists of several parts: the recognition system; a checking pass; a correcting pass; and a clean up pass. The recognition system was developed at NIST. The checking pass verifies that an image is in the correct class. The correcting pass allows classes to be changed. The clean-up pass forces the system to stabilize by accepting images with verified classifications while rejecting all others. In developing the testing set the authors discovered that segmented characters can be ambiguous even without context bias. The ambiguity can be caused by over-segmentation or by the way a person writes. This means that a quoted accuracy rate for a set of segmented characters is meaningless without reference to human performance on the same set of characters. GRA

N93-24654* National Aeronautics and Space Administration, Washington, DC.
NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS: A CATALOG OF SPECIAL PUBLICATIONS, REFERENCE PUBLICATIONS, CONFERENCE PUBLICATIONS, AND TECHNICAL PAPERS, 1991-1992
Feb. 1993 119 p
(NASA-SP-7063(06); NAS 1.21:7063(06)) Avail: CASI HC free

This catalog lists 458 citations of all NASA Special Publications, NASA Reference Publications, NASA Conference Publications, and NASA Technical Papers that were entered into the NASA Scientific and Technical Information database during accession year 1991 through 1992. The entries are grouped by subject category. Indexes of subject terms, personal authors, and NASA report numbers are provided. Author

N93-22142# Tokai Univ., Tokyo (Japan). Research and Information Center.
LASER DISC FOR EARTH ENVIRONMENT DATA SET Abstract Only
Haruhisa Shimoda and Toshibumi Sakata *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 293-295 (For primary document see N93-22119 08-43)
Avail: CASI HC A01/MF A03

N93-22143# Canada Centre for Remote Sensing, Ottawa (Ontario). Ice Applications.
ENVIRONMENTAL DATA SETS IN CANADA

Michael J. Manore *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 299-310 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

N93-22145# National Research Council, Bangkok (Thailand). Remote Sensing Center.
ENVIRONMENTAL DATA SET IN THAILAND
Chanchai Peanvijarnpong *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 325-340 (For primary document see N93-22119 08-43)
Avail: CASI HC A03/MF A03

N93-22146# Alaska Univ., Fairbanks. Geophysical Inst.
ENVIRONMENTAL DATA SETS AT THE UNIVERSITY OF ALASKA
J. M. Miller and T. H. George *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 341-347 (For primary document see N93-22119 08-43)
Avail: CASI HC A02/MF A03

N93-22147# Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Oceanography.
ENVIRONMENTAL DATA SETS FOR INTERNATIONAL SPACE YEAR ACTIVITIES IN AUSTRALIA
Carl S. Nilsson and Jeff Kingwell (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia.) *In* NASDA, The Second International Conference on Japanese Earth Observation Programs: Proceedings of Pre ISY International Symposium 31 Jan. 1992 p 349-354 (For primary document see N93-22119 08-43)
Avail: CASI HC A01/MF A03

N93-22152*# Advanced Communications Technology, Inc., Silver Spring, MD.
UNIVERSAL INDEX SYSTEM
Steve Kelley, Nick Roussopoulos, Timos Sellis, and Sarah Wallace *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 18-28 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

N93-22153*# Netrologic, Inc., San Diego, CA.
THE DEVELOPMENT OF A NATURAL LANGUAGE INTERFACE TO A GEOGRAPHICAL INFORMATION SYSTEM
Sue Walker Toledo and Bruce Davis *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 29-42 Prepared for NASA, John C. Stennis Space Center, Bay Saint Louis, MS (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

N93-22154*# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.
AN APPLICATION PROTOCOL FOR CAD TO CAD TRANSFER OF ELECTRONIC INFORMATION
Charles C. Azu, Jr. *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 45-54 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22155*# Analex Space Systems, Inc., Cocoa Beach, FL.
METHODS AND MEANS USED IN PROGRAMMING INTELLIGENT SEARCHES OF TECHNICAL DOCUMENTS
David L. Gross *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 55-62 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22156*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN INTEGRATED INFORMATION RETRIEVAL AND DOCUMENT MANAGEMENT SYSTEM
L. Stephen Coles, J. Fernando Alvarez, James Chen, William Chen, Lai-Mei Cheung, Susan Clancy, and Alexis Wong *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 63-72 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22171*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF INTERACTIVE MULTIMEDIA APPLICATIONS
Albert Leigh (McDonnell-Douglas Space Systems Co., Houston, TX.) and Lui Wang *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 217-225 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22192*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE DATA EGG: A NEW SOLUTION TO TEXT ENTRY BARRIERS
Gary L. Friedman *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 409-418 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-22193*# General Electric Co., Houston, TX. Government Services.
MIRAGE: THE DATA ACQUISITION, ANALYSIS, AND DISPLAY SYSTEM
Robert S. Rosser and Hasan H. Rahman *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 419-428 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

N93-23854# United Nations Educational, Scientific and Cultural Organization, Paris (France). Society for the Study of Law and Policy on Space Utilization.
SATELLITE DATA PROTECTION FROM THE POINT OF VIEW OF A DATA USER: PREPARATION FOR FULL UTILIZATION OF REMOTE SENSING TECHNOLOGY
Kumon Tokumaru *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1495-1500 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24383# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).
INFORMATION HANDLING AS TASK LAYER OF COLUMBUS USER SUPPORT
H. Duwe, P. Vielcanet (CISI Ingenierie, Toulouse, France.), T. A. E. Andersen (Danish Aerospace Medical Center of Research, Copenhagen.), H. T. Blume, M. P. A. M. Brouwer (National Aerospace Lab., Emmeloord, Netherlands.), L. DAngelo (Microgravity Advanced Research and Support Center, Naples, Italy.), N. Eilersen (Danish Aerospace Medical Center of Research, Copenhagen.), M. Gaida, M. Herten, and T.-H. Iversen (Trondheim Univ., Norway.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 263-268 (For primary document see N93-24336 08-12)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24545*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA COMPRESSION OPPORTUNITIES IN EOSDIS
Ben Kobler and John Berbert *In its* The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 3-5 (For primary document see N93-24544 08-59)
Avail: CASI HC A01/MF A02

N93-24546*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COMPRESSION THROUGH DECOMPOSITION INTO BROWSE AND RESIDUAL IMAGES
Dmitry A. Novik (Universal Systems, Inc., Arlington, VA.), James C. Tilton, and M. Manohar (Universities Space Research Association, Greenbelt, MD.) *In its* The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 7-12 (For primary document see N93-24544 08-59)
Avail: CASI HC A02/MF A02

N93-24547*# Los Alamos National Lab., NM. Computer Research Group.
APPLICATIONS OF WAVELET-BASED COMPRESSION TO MULTIDIMENSIONAL EARTH SCIENCE DATA
Jonathan N. Bradley and Christopher M. Brislawn *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 13-24 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

N93-24548*# TRW Systems Group, Redondo Beach, CA.
WAVELET ENCODING AND VARIABLE RESOLUTION PROGRESSIVE TRANSMISSION
Ronald P. Blanford *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 25-35 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

N93-24549*# Florida Univ., Gainesville. Dept. of Electrical Engineering.
FAST IMAGE DECOMPRESSION FOR TELEBROWSING OF IMAGES
Shaou-Gang Miaou and Julius T. Tou *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 37-48 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

N93-24550*# University of North Texas, Denton. Dept. of Computer Science.
A SURVEY OF QUALITY MEASURES FOR GRAY-SCALE IMAGE COMPRESSION
Ahmet M. Eskicioglu and Paul S. Fisher *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 49-61 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

N93-24552*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A STUDY OF VIDEO FRAME RATE ON THE PERCEPTION OF MOVING IMAGERY DETAIL
Richard F. Haines (RECOM Technologies, Inc., Moffett Field, CA.) and Sherry L. Chuang *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 75-84 (For primary document see N93-24544 08-59)
Avail: CASI HC A02/MF A02

N93-24553*# Hughes STX, Inc., Greenbelt, MD. Cosmology Data Analysis Center.
SYSTEMS ASPECTS OF COBE SCIENCE DATA COMPRESSION
I. Freedman, E. Boggess, and E. Seiler *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 85-97 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

N93-24554*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROPOSED DATA COMPRESSION SCHEMES FOR THE GALILEO S-BAND CONTINGENCY MISSION
Kar-Ming Cheung and Kevin Tong *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 99-109 (For primary document see N93-24544 08-59)
Avail: CASI HC A03/MF A02

N93-24555*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA COMPRESSION FOR THE CASSINI RADIO AND PLASMA WAVE INSTRUMENT
W. M. Farrell, D. A. Gurnett (Iowa Univ., Iowa City.), D. L. Kirchner (Iowa Univ., Iowa City.), W. S. Kurth (Iowa Univ., Iowa City.), and L. J. C. Woolliscroft (Sheffield Univ., England.) *In its* The 1993 Space and Earth Science Data Compression Workshop Apr. 1993 p 111-120 (For primary document see N93-24544 08-59)
Avail: CASI HC A02/MF A02

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N93-22404# General Accounting Office, Washington, DC. National Security and International Affairs Div.
SPACE PROGRAMS: NASA'S INDEPENDENT COST ESTIMATING CAPABILITY NEEDS IMPROVEMENT
Nov. 1992 9 p
(AD-A259263; GAO/NSIAD-93-73) Avail: CASI HC A02/MF A01

This report responds to a request that we determine whether NASA implemented an advisory committee's recommendation to strengthen NASA's independent cost estimating capability. Congress and the executive branch need accurate cost estimates in deciding whether to undertake or continue space programs which often cost millions or even billions of dollars. In Dec. 1990, the Advisory Committee on the Future of the US Space Program found that initial estimates of required resources too often have been understated. The committee recommended that NASA establish an independent cost analysis group to advise the administrator on estimates being provided to Congress and the Office of Management and Budget.
GRA

N93-22935# Oak Ridge National Lab., TN.
SUMMARY OF ACTIVITIES OF THE LIFE CYCLE COSTING WORKSHOP CONDUCTED BY THE ENVIRONMENTAL RESTORATION PROGRAM OF OAK RIDGE NATIONAL LABORATORY
Aug. 1992 265 p Presented at the Life Cycle Costing Workshop, Oak Ridge, TN, 14-18 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-000823; ORNL/ER-117; CONF-9110457-Summ) Avail: CASI HC A12/MF A03

A five-day life cycle workshop was conducted by the Environmental Restoration (ER) Program of Oak Ridge National Laboratory (ORNL) to develop appropriate remediation scenarios for each Waste Area Grouping (WAG) at ORNL and to identify associated data needs (e.g., remedial investigations, special studies, and technology demonstrations) and required interfaces. Workshop participants represented the Department of Energy, Martin Marietta Energy Systems, Inc., Bechtel National, Radian Corporation, EBASCO Corporation, and M-K Ferguson. The workshop was used to establish a technical basis for remediation activities at each WAG. The workshop results are documented and provide the baseline for estimating the technical scope for each WAG. The scope and associated budgets and schedules will be summarized in baseline reports for each WAG, which, in turn, will be compiled into an overall strategy document for ORNL ER.
DOE

N93-23097# General Accounting Office, Washington, DC. National Security and Internal Affairs Div.
SPACE TRANSPORTATION: THE CONTENT AND USES OF SHUTTLE COST ESTIMATES. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT, COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, HOUSE OF REPRESENTATIVES
Jan. 1993 15 p
(GAO/NSIAD-93-115; B-251737) Avail: CASI HC A03/MF A01; GAO, PO Box 6015, Gaithersburg, MD 20877 HC

This report responds to the former Chairman's request that we review the National Aeronautics and Space Administration's (NASA) estimates of the Space Shuttle's average cost per flight and marginal cost per flight. The Congress needs to understand the content of these estimates to avoid confusion over what it costs to fly the shuttle. Our specific objectives

were to determine (1) what costs are included in or excluded from each estimate and (2) how these costs should be allocated to NASA payload missions that are transported to space in the shuttle. Derived from text

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N93-22900# Space Policy Advisory Board, Washington, DC. Office of the Vice President.
POST COLD WAR ASSESSMENT OF US SPACE POLICY: A TASK GROUP REPORT
Dec. 1992 80 p
(PB93-139962) Avail: CASI HC A05/MF A01

On August 31, 1992 a special task group of the Space Policy Advisory Board reviewed the nation's space policies in the context of the end of the Cold War and other developments. The report focuses on four recommendations. They are that: (1) major changes be made in the way government space activities are organized and managed, eliminating duplication and fostering synergism among civil, military, intelligence, and commercial space programs; (2) the government seek to reduce, and where possible eliminate, security constraints associated with national security space programs; (3) the government take a series of actions on an urgent basis to create a more cooperative and productive relationship with the U.S. space industry; and (4) the United States take the initiative in shaping a common international agenda in selected areas of civilian and national security space activity to address global problems and to maintain U.S. influence. Derived from text

N93-23679# Executive Office of the President, Washington, DC.
POINTS OF LIGHT MOVEMENT: THE PRESIDENT'S REPORT TO THE NATION
Jan. 1993 244 p
(PB93-139780) Avail: CASI HC A11/MF A03

This is President Bush's report to the Nation on the Points of Light movement. It outlines the movement's purpose, its national strategy, the accomplishments of the last four years, and the challenges of the years to come. GRA

N93-23850# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany).
EUMETSAT PRACTICE FOR PROTECTION OF ITS SATELLITE DATA
Volker Thiem *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1467-1470 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23851# SPOT Image Corp., Toulouse (France).
PROTECTION OF SPOT DATA AND DERIVED PRODUCTS UNDER PRIVATE AGREEMENTS, THE LAW AND INTERNATIONAL CONVENTIONS
Luc Dufresne *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1471-1475 Presented at Colloquium on Legal Aspects of the Use of Satellite Remote Sensing Data in Europe, Munich, Germany, 11 Mar. 1992 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23852*# National Aeronautics and Space Administration, Washington, DC.
US DATA POLICY FOR EARTH OBSERVATION FROM SPACE
Lisa Robock Shaffer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1477-1481 (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23853# Paris IX Univ., Dauphine (France).
CONDITIONS OF ACCESS TO EARTH OBSERVATION DATA: LEGAL ASPECTS [PRESENTATION DE L'ETUDE CEE RELATIVE AUX ASPECTS JURIDIQUES DE LA TELEDETECTION]
Philippe Gaudrat *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1483-1494 In FRENCH (For primary document see N93-23748 08-43)
Copyright Avail: CASI HC A03/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23855# Max-Planck-Inst. for Foreign and International Patent, Copyright and Competition Law, Munich (Germany).
INTERNATIONAL LAW PERSPECTIVE ON ESTABLISHING A EUROPEAN REGULATION WITH REGARD TO THE LEGAL PROTECTION OF THE USE OF SATELLITE REMOTE SENSING DATA
Thomas K. Dreier *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 3: Earth Observation Space Programmes, SAFISY Activities, Strategies of International Organisations, Legal Aspects 1992 p 1501-1504 (For primary document see N93-23748 08-43)
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85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N93-22903# Federal Highway Administration, Washington, DC.
HIGH SPEED GROUND TRANSPORTATION STUDY: EXECUTIVE SUMMARY
Oct. 1992 33 p
(PB93-141091) Avail: CASI HC A03/MF A01

In 1991, the Washington State Legislature enacted Chapter 231, Laws of 1991 (SHB 1452), which directed that a comprehensive assessment be made of the feasibility of developing a high speed ground transportation (HSGT) system in Washington state. The legislation came about because there was a growing recognition that major transportation corridors were reaching unacceptable levels of congestion, and that even though most large metropolitan areas were developing specific plans to ease that congestion within their urban boundaries, inter-city travel between those areas was becoming increasingly difficult. The study area included Washington plus the Portland, Oregon urban area and the lower mainland of British Columbia. Two major corridors were identified and analyzed. The study was not meant to focus on the technologies but rather on the economic, environmental, institutional, and financial feasibility of implementing HSGT in this state. The study was not meant to be a 'siting' study. Alignments and station locations were assumed only to test feasibility, and to evaluate corridors and service areas. Specific location decisions will require more detailed engineering and operations studies. GRA

N93-24482*# Alabama Univ., Huntsville.
TECHNOLOGY TRANSFER FROM NASA TO TARGETED INDUSTRIES, VOLUME 1
Wayne McCain, Bernard J. Schroer, William E. Souder, Mary S. Spann, Harry Watters, and M. Carl Ziemke Mar. 1993 86 p

(Contract NCC8-18)
(NASA-CR-192757; NAS 1.26:192757; CAR-93-05-Vol-1) Avail: CASI HC A05/MF A01

This report summarizes the University of Alabama in Huntsville (UAH) technology transfer to three target industries with focus on the apparel manufacturing industry in Alabama. Also included in this report are an analysis of the 1992 problem statements submitted by Alabama firms, the results of the survey of 1987-88 NASA Tech Brief requests, the results of the followup to Alabama submitted problem statements, and the development of the model describing the MSFC technology transfer process. Author

N93-24484*# Alabama Univ., Huntsville.
TECHNOLOGY TRANSFER FROM NASA TO TARGETED INDUSTRIES, VOLUME 2
Wayne McCain, Bernard J. Schroer, William E. Souder, Mary S. Spann, Harry Watters, and M. Carl Ziemke Mar. 1993 143 p
(Contract NCC8-18)
(NASA-CR-192758; NAS 1.26:192758; CAR-93-06-Vol-2) Avail: CASI HC A07/MF A02

This volume contains the following materials to support Volume 1: (1) Survey of Metal Fabrication Industry in Alabama; (2) Survey of Electronics Manufacturing/Assembly Industry in Alabama; (3) Apparel Modular Manufacturing Simulators; (4) Synopsis of a Stereolithography Project; (5) Transferring Modular Manufacturing Technology to an Apparel Firm; (6) Letters of Support; (7) Fact Sheets; (8) Publications; and (9) One Stop Access to NASA Technology Brochure. Author

88 SPACE SCIENCES (GENERAL)

N93-23878# European Space Agency, Paris (France).
ENVIRONMENT OBSERVATION AND CLIMATE MODELLING THROUGH INTERNATIONAL SPACE PROJECTS. SPACE SCIENCES WITH PARTICULAR EMPHASIS ON HIGH-ENERGY ASTROPHYSICS
T. Duc Guyenne, ed. and James J. Hunt, ed. Jul. 1992 218 p Conference held in Munich, Germany, 30 Mar. - 4 Apr. 1992; sponsored by CEC, ESA, Deutsche Agentur fuer Raumfahrtangelegenheiten, and the European Association for the International Space Year
(ESA-ISY-3; ETN-93-93506) Copyright Avail: CASI HC A10/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The European International Space Year conference was held with the specific theme of the practical use of space derived information for environmental research and monitoring, and resource management. The main theme, 'Mission to Planet Earth', was maintained, but it was recognized that other fields needed to be equally addressed to provide a balanced view on space activities. Space sciences, space navigation and communications, and manned space activities were also represented. The present volume consists of papers addressing in particular infrared, gamma ray, and spaceborne astronomy. Several reports relate to the Rosat X-ray astronomy satellite. Other missions covered include Hipparcos, the Hubble Space Telescope and FIRST (Far Infrared and Submillimeter Telescope). Solar studies and planetary exploration are also reported. For individual titles, see N93-23879 through N93-23934.

N93-23879# Lund Observatory (Sweden).
STATUS AND EARLY RESULTS OF THE HIPPARCOS ASTROMETRY PROJECT **c90**
L. Lindegren *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 3-8 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

A report on the status and early results of the ESA astrometry mission Hipparcos, launched in 1989, which aims at the construction of a uniquely accurate and uniform catalog of positions, parallaxes, proper motions and photometric information for 118,000 preselected program stars, is presented. Additional data for up to a million stars will be obtained by the Tycho part of the mission. The first results of the lengthy catalog construction process are available in the three data reduction consortia. The early (and provisional) star positions and distance estimates give a dramatic indication of the outstanding scientifc potential of the mission. In spite of the many difficulties and losses caused by a faulty orbit it is now expected that the nominal goal of 2 milliarcsec accuracy (for typical stars) will be reached around 1993.0 and even surpassed for a longer mission. ESA

N93-23880# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
THE ROSAT ALL-SKY X RAY SURVEY **c89**
Wolfgang Voges *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 9-19 (For primary document see N93-23878 08-88)
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The Rosat X-ray astronomy satellite has completed the first all sky X-ray and XUV survey with imaging telescopes. About 60,000 new X-ray and 400 new XUV sources were detected. Preliminary results from the Rosat All Sky X-ray Survey are addressed. The Rosat X-ray Skymap, the positional accuracy obtained for the X-ray sources, general information on their properties, and first results from correlations performed with available catalogs in various energy bands like the radio, infrared, visible, UV, and hard X-rays as well as identifications from optical follow up observations are presented. ESA

N93-23881# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
OVERVIEW OF FIRST OBSERVATIONS WITH THE FRENCH TELESCOPE SIGMA ON BOARD GRANAT **c89**
P. Mandrou, J. P. Roques, G. Vedrenne, M. Niel, J. Paul (Commissariat a l'Energie Atomique, Saclay, France.), J. P. Leray (Commissariat a l'Energie Atomique, Saclay, France.), F. Lebrun (Commissariat a l'Energie Atomique, Saclay, France.), J. Ballet (Commissariat a l'Energie Atomique, Saclay, France.), E. Churazov (Academy of Sciences, USSR, Moscow.), and M. Gilfanov (Academy of Sciences, USSR, Moscow.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 21-26 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The hard X-rays, low energy gamma ray telescope SIGMA, one of the main instruments on board the Soviet satellite GRANAT, has performed sky observations in the 35 keV to 1.3 MeV range, both in galactic and extragalactic sources with unprecedent angular resolution in such an energy domain. New results were obtained by imaging the Galactic center region with a 1.5 arc minute accuracy during more than 400 hours distributed in five periods which took place in early Spring and Summer from 1990 to 1992. The 6 by 6 deg region centered on the Galactic center contains more than six highly variable sources in the 100 keV domain. Hard X-ray binaries and bright extragalactic objects were also analyzed and monitored during these observations. The main result obtained by SIGMA was to point out the variability of the sky in the hard X-ray domain. ESA

N93-23882# Amsterdam Univ. (Netherlands). Inst. of Astronomy.
ENDPOINTS OF STELLAR EVOLUTION: THE INCIDENCE OF STELLAR MASS BLACK HOLES IN THE GALAXY **c90**
Edward P. J. vandenHeuvel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 29-36 (For primary document see N93-23878 08-88)
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The various possible endpoints of stellar evolution are discussed. Special consideration is given to the question of the number of stellar mass black holes present in the galaxy. From stellar evolution considerations together with the incidence of Low Mass X-ray Binaries that contain black holes it is argued that the number of stellar mass (approximately 5 to 15 solar mass) black holes in the Galaxy must be of order 10 to eighth power. Even if all helium in the Universe had been made in an early population of very massive stars, the number of stellar mass black holes in the Galaxy would not exceed 6 times 10 to the 9th power. ESA

N93-23883# Hamburger Sternwarte G.m.b.H. (Germany).
GRAVITATIONAL LENSES **c89**
Sjur Refsdal *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 37-40 (For primary document see N93-23878 08-88)
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The observed microlensing variability of QSO 2237+0305 has already given important information in the structure of the quasar, the mass of the stars which causes the microlensing, and the transverse motions involved. A discussion on how more precise information can be obtained if observations can also be carried out from a space observatory some astronomical units away from the Earth, since in this case the spatial gradient of the observed flux can be measured, is presented. The inclusion of a telescope (greater than or equal to 20 cm) for such observations in a future space mission is proposed. ESA

N93-23884# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
ROSAT OBSERVATIONS OF SUPERNOVA REMNANTS AND THE INTERSTELLAR MEDIUM **c89**
Bernd Aschenbach *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 41-48 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Spectrally resolved X-ray images of galactic Supernova Remnants (SNR) were obtained both from the Rosat All Sky Survey and a series of pointed observations. There is substantial evidence for significant spatial variation in temperature, density and pressure across the older, thermal remnants like the Vela SNR, the Cygnus Loop and the North Polar Spur. Both the brightness distribution and the pressure variations observed point towards recently shocked interstellar clouds and filaments, which dominate the X-ray emission pattern. Across the Puppis-A SNR an arc shaped absorption structure was detected, which is interpreted as cold gas located close to the shock front of the Vela SNR. ESA

N93-23885# European Space Agency, Paris (France).
HORIZON 2000 AND EUROPEAN NATIONAL PROGRAMMES
R. M. Bonnet *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 51-57 (For primary document see N93-23878 08-88)
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A review on ESA's science program is presented. Five missions still in orbit are outlined: IUE, Giotto, Hipparcos, Hubble Space Telescope, and Ulysses. Objectives of the Horizon 2000 program are described. Solar system exploration in Horizon 2000 concerns: the SOHO (Solar and Heliospheric Observatory) and Cluster missions, Cassini/Huygens to Saturn and Titan, and the Rosetta Comet Nucleus Sample Return (CNSR). Astronomy in Horizon 2000 concerns ISO (Infrared Space Observatory), the X-ray Multimirror Mission (XMM) and FIRST (Far Infrared and Submillimeter Space Telescope). Medium sized missions of Horizon 2000 include INTEGRAL (International Gamma Ray Astrophysical Laboratory), MARSNET (a network of lander modules in Mars), and STEP (Satellite Test of the (weak) Equivalent Principle). Small missions include extension of Giotto and instruments to fly on Eureca, the Columbus Space Station, and the Polar Platform. ESA

N93-23886# Rome Univ. (Italy). Ist. Astronomico.
ACTIVE GALACTIC NUCLEI: THE VIEW FROM SPACE **c90**
G. C. Perola *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 59-65 (For primary document see N93-23878 08-88)
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The extension of the energy output from Active Galactic Nuclei (AGN) throughout the whole electromagnetic spectrum is addressed. The relevance of space observations for the understanding of this phenomenon is illustrated by describing some of the results obtained with Exosat and Ginga on their X-ray emission. In particular spectral properties and variability are reviewed along with their most immediate implications for model pictures of AGN. ESA

N93-23887# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
X RAY MORPHOLOGY AND THE MASS OF CLUSTERS OF GALAXIES **c90**
Ulrich G. Briel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 67-75 (For primary document see N93-23878 08-88)
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Rosat all sky survey data of the brightest clusters of galaxies, like Virgo, Perseus, and Coma, are presented. These observations reveal new information on the dynamical state of the galaxy clusters. Coma, for example, the archetype of a relaxed virialized cluster shows clear evidence for substructure: a concentration of galaxies, found already on the optical, is in fact a physical object and appears to be in the process of merging with the cluster. In pointed observations of clusters of galaxies substructure becomes even more evident. A2256, a Coma like cluster, is the first object in which the merging of a group and a cluster of galaxies was found. In addition, long pointed observations enable us to measure for the first time an azimuthally averaged temperature distribution, as will be shown for A2256. These data can be used to determine the distribution of dark matter in the cluster and to measure its mass. ESA

N93-23888# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
ROSAT OBSERVATIONS OF ACTIVE GALACTIC NUCLEI **c89**
Henner H. Fink *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 77-87 (For primary document see N93-23878 08-88)
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Detailed studies of the X-ray spectra of well known Active Galactic Nuclei (AGN) from different object classes are reported. It was found that there are no indications in the spectra of BL Lac objects of low energy absorption due to cold and dense material in their X-ray emitting regions. On the other hand, absorption line features were found below 1 keV indicating the probable existence of highly ionized matter in these objects. The convex (0.1 to 20) keV spectrum of MKN 421 is presented, which was obtained by combining the data simultaneously measured with Rosat and Ginga in a single fit. As examples for X-ray spectra of bright AGN, those of archetypal Quasi Stellar Objects (QSOs) are presented, the radio loud quasar 3C 273 and the radio quiet QSO 1821 + 64, respectively, both of which exhibit variable soft X-ray excesses. ESA

N93-23889# Space Telescope Science Inst., Baltimore, MD.
SOLAR SYSTEM OBSERVATIONS WITH HST **c89**
Francesco Paresce (European Space Agency, Paris, France.) and Jean-Claude Gerard (Liege Univ., Belgium.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 91-94 (For primary document see N93-23878 08-88)
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Imaging and spectrographic measurements of solar system objects with the Hubble Space Telescope (HST) are reviewed from a scientific and technical standpoint. Special emphasis is placed on observations of Jupiter and Io during the Ulysses encounter by the Faint Object Camera and HRS. The bottom line is that, although the mirror aberration limits HST's extragalactic performance, the potential for a deep systematic probe of planetary conditions over a wide range of observing conditions is still practically intact and will get better as the bugs are ironed out and the COSTAR (Corrective Optics Space Telescope Axial Replacement) fix is implemented. ESA

N93-23890# Observatoire de Paris-Meudon (France). Dept. de Recherche Spatiale.

SPACE EXPLORATION OF PLANETARY AND SATELLITE ATMOSPHERES **c91**

Therese Encrenaz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 95-101 (For primary document see N93-23878 08-88)

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Progress on the space exploration of solar system objects is discussed. Terrestrial planets have been extensively studied for twenty years using orbiters and descent probes which allowed in situ measurements of their atmospheres (Mariner, Viking, Venera spacecrafts). The atmospheres of the giant planets and their satellites have been investigated by fly-by missions (Pioneer and Voyager) which could perform remote sensing observations (imaging and spectroscopy). Future plans include the long term exploration of Mars and the extended exploration of the Jovian and Saturnian systems. ESA

N93-23891*# Johns Hopkins Univ., Laurel, MD. Center for Astrophysical Sciences.

REVIEW OF RESULTS FROM THE HOPKINS ULTRAVIOLET TELESCOPE ABOARD THE ASTRO-1 MISSION **c89**

A. F. Davidsen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 105-110 (For primary document see N93-23878 08-88)

(Contract NAS5-27000)

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The Hopkins Ultraviolet Telescope (HUT), flown aboard the Space Shuttle Columbia in the Astro-1 mission, provided the first spectrophotometry in the sub Kyman alpha region for many astronomical sources. Observations of 77 sources were made throughout the far ultraviolet (912 to 1850 A, delta lambda approximately 3 A), and for a few objects in the extreme ultraviolet (415 to 912 A, delta lambda approximately 1.5 A). Among the objects observed were quasars, galaxy clusters, active and normal galaxies, cataclysmic variables, globular clusters, supernova remnants, planetary nebulae, and white dwarfs. ESA

N93-23892# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

OBSERVATION OF THE EXTRAGALACTIC X RAY BACKGROUND **c89**

Guenther Hasinger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 111-117 (For primary document see N93-23878 08-88)

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A series of 32 deep pointed observations with the Rosat PSPC (Position Sensitive Proportional Counter) is discussed. Nine hundred fifty-five X-ray sources with 0.5 to 2 keV fluxes down to 3 x 10(exp -15) erg/sq cm(s) were discovered in 9.8 deg(exp 2). The N(greater than S) relation of the sources selected in the 0.5 to 2 keV band shows a density in excess of approximately 250/deg squared at the faintest fluxes and a flattening below 2 x 10(exp -14) erg/sq cm(s). The average spectrum of those sources is a power law with energy index 1.09 +/- 0.07. The absorption column densities are consistent with the galactic H 1 columns. More than 50 percent of the 1 to 2 keV background was resolved into discrete sources in the deepest fields. The total background spectrum shows an emission line feature around 0.65 keV, most probably due to O7-O8 from a 2,000,000 plasma. Above approximately 1 keV the background is dominated by a power law spectrum with a normalization of 13.6 +/- 0.2 KeV/sq cm/(s)(sr)(keV) and a slope 1.04 +/- 0.06, i.e. considerably steeper than the extrapolation from higher energies. ESA

N93-23893*# Hoyle (Fred), Bournemouth (England).

GAMMA RAY BURSTS FROM EXTRAGALACTIC SOURCES **c93**

Fred Hoyle and Geoffrey Burbidge (California Univ., La Jolla.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 119-123 (For primary document see N93-23878 08-88)

(Grant NAGw-1737)

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The properties of gamma ray bursts of classical type are found to be explicable in terms of high speed collisions between stars. A model is proposed in which the frequency of such collisions can be calculated. The model is then applied to the nuclei of galaxies in general on the basis that galaxies, or at least some fraction of them, originate in the expulsion of stars from creation centers. Evidence that low level activity of this kind is also taking place at the center of our own Galaxy is discussed. The implications for galactic evolution are discussed and a negative view of black holes is taken. ESA

N93-23894# European Southern Observatory, Garching (Germany).

ARCHIVAL AND ANALYSIS OF HUBBLE SPACE TELESCOPE DATA **c89**

R. Albrecht (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), F. Pasian, and B. Pirenne *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 127-131 (For primary document see N93-23878 08-88)

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The experiences gained during the operation of the archival/data analysis system, after almost two years of orbital operations of the Hubble Space Telescope (HST), are described with particular emphasis on system operation in an internationally networked, multisystem, academic environment, which has, at least in some areas, industry type development, interface, reliability, security, and throughput requirements imposed on it. The data analysis system resides on a network of distributed processors, running mostly UNIX machines. Since HST data are worked on worldwide with many different software systems, the user community is provided with the most important systems in which HST data analysis and calibration software has been written: STSDAS (Space Telescope Science Data Analysis System) and IDL (Interactive Data Language). ESA

N93-23895# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.

THE IUE ARCHIVE(S) **c89**

Michael Barylak and Daniel Ponz *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 133-136 (For primary document see N93-23878 08-88)

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The different aspects and applications of the archive of the International Ultraviolet Explorer (IUE) satellite are summarized. A review of the current activities is given. A major aspect is the reprocessing of all IUE observations with a new and enhanced spectral image processing sofware (NEWSIPS). A summary of all available output products such as the many atlases, bibliographic references, and the Uniform Low Dispersion Archive ULDE is given to highlight IUE observations as a prolific source of science. Some of the future aspects of the IUE archives are outlined. ESA

N93-23896# European Southern Observatory, Garching (Germany).

DATA ANALYSIS AND ARCHIVES IN ASTRONOMY: A PERSPECTIVE VIEW **c89**

B. Benvenuti (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 137-138 (For primary document see N93-23878 08-88)

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An overview of the data analysis and archiving of astronomical observations is presented. A key factor for a proper analysis of the situation is the average time interval for the obsolescence or renewal of hardware configurations and software tools. The development of interactive data analysis programs and systems over the last 15 years and problems related

to portability and adaptability of software are reviewed. The use of workstations designed to be installed and run by individuals rather than by 'computer centers' means that the astronomer must often become the computer manager. A critical review of medium to long term plans is required. ESA

N93-23897# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

IRAS GALAXIES IN THE ROSAT SURVEY **c89**

T. Boller, E. J. A. Meurs, M. Dennefeld (Institut d'Astrophysique, Paris, France.), W. Brinkmann, H. Fink, U. Zimmermann, and H.-M. Adorf (European Southern Observatory, Garching, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 139-140 (For primary document see N93-23878 08-88)

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A sample of 14708 extragalactic IRAS sources selected from the Point Source Catalog via statistical classification were cross correlated with the Rosat All Sky Survey. An unexpected result that emerged from early Rosat work is the detection of X-ray luminous IRAS LINER's with luminosities up to 10(exp 43) erg/s well above those found with the Einstein satellite (a few 10(exp 41) erg/s). Tentative explanations for the detection of these X-ray luminous LINER galaxies are given. ESA

N93-23898# Institute of Physical and Chemical Research, Saitama (Japan). Cosmic Radiation Lab.

X RAY SPECTRAL STRUCTURE OF THE SEYFERT 2 GALAXY NGC 5506 **c89**

I. A. Bond, M. Matsuoka, and M. Yamauchi *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 141-142 (For primary document see N93-23878 08-88)

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Observations of the Seyfert 2 galaxy NGC5506 by Ginga from 6-10 Jul. 1991 are discussed. The spectrum obtained on 9 Jul. was found to be consideraby softer below 3 keV compared with the other observation days. The spectra are each best described by a composite partial covering model and reflection model. While the presence of ionized matter is not ruled out, the lack of correlation of the spectral softness with the continuum flux rules out models based on photoionization as the softness variability mechanism. In reality the soft excess seen in NGC 5506 is probably complex and comprises several components. ESA

N93-23899# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

EXTRAGALACTIC RADIO SOURCES IN THE ROSAT SURVEY **c93**

W. Brinkmann, T. Boller, and J. Siebert *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 143-144 (For primary document see N93-23878 08-88)

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The cross correlation of radio catalogs with the source list from the Rosat All Sky Survey yields a large number of mostly previously optically unidentified extragalactic objects. Amongst the 'known' sources the biggest subgroup is formed by quasars, followed by radio galaxies. From the correlations a total of more than 2500 radio X-ray sources is available for the statistical and morphological study of extragalactic objects. ESA

N93-23900# Landessternwarte auf dem Koenigstuhl, Heidelberg (Germany).

EMISSION FROM RELATIVISTIC JETS IN BLAZARS **c93**

M. Camenzind *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 145-146 (For primary document see N93-23878 08-88)

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The relativistic jets observed in quasars and BL Lac objects are nothing else than magnetically collimated disk winds. On the parsec scale, the radius of these outflows is of the order of a few light cylinder radii for magnetic surfaces anchored near the inner edge of the accretion disk. The disk plasma is accelerated to Lorentz factors of approximately or equal to 10, depending on the magnetization of the disk. Relativistic motion of knots and variability in the emission from blazars are related to nonaxisymmetric bubbles carried along by the plasma in relativistic magnetized jets. The intense gamma radiation detected by GRO (Gamma Ray Observatory) in the direction of flat spectrum quasars and BL Lac objects is naturally explained in terms of inverse Compton emission from young knots ejected along the jet channel. ESA

N93-23901# Consejo Superior de Investigaciones Cientificas, La Laguna (Spain). Inst. de Astrofisica de Canarias.

THE X RAY TRANSIENT GS2023+338: THE 0(SUP d).24 AND 6(SUP d).5 MODULATIONS **c93**

J. Casares, P. A. Charles (Royal Greenwich Observatory, Tenerife, Spain.), and E. P. Pavlenko (Crimean Astrophysical Observatory, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 147-148 (For primary document see N93-23878 08-88)

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High resolution spectrophotometry of the black hole system V404 Cyg during quiescence, performed during 1990 and 1991, is discussed. In addition to a 6.5(sup d) orbital modulation, there is strong evidence of a 0.24(sup d) periodicity in both the H alpha emission radial velocities and the continuum flux. The relative phasing between the photometric and spectroscopic 0.24(sup d) modulations is somewhat puzzling and several interpretations are discussed. Some hints of ellipsoidal modulation in the 6.5(sup d) period are also presented. ESA

N93-23902# European Southern Observatory, Garching (Germany).

HST IMAGING OF THE BINARY PULSAR PSR1913+16 **c89**

Philippe Crane *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 149-151 (For primary document see N93-23878 08-88)

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An image of the region of the binary pulsar PSR1913+16 obtained with the Planetary Camera on board the Hubble Space Telescope is presented and discussed. The image clearly shows the object previously thought to be coincident with the radio timing position of the pulsar. The astrometric solution confirms the positional coincidence. The object appears slightly elongated in both of the images obtained. If this object is indeed associated with the binary pulsar, then the clean interpretation of the timing data as evidence for gravitational radiation may be in doubt. ESA

N93-23903# Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn (Germany).

THE GERMAN SPACE SCIENCE PROGRAMME

Ferdinand Dahl *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 153-154 (For primary document see N93-23878 08-88)

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The German extraterrestrial basic research program comprises projects of astronomy/astrophysics and solar terrestrial relations, with the subareas of aeronomy (physics of the upper atmosphere), magnetospheric and plasma physics as well as planetary and cometary physics. The objective of the program is the continuous promotion of space science in Germany through a national program, through participation in the ESA space science program and in bilateral projects as well as support of in-house initiatives of the research institutes. ESA

N93-23904# European Space Agency. ESA Tracking Station, Madrid (Spain). Lab. de Astrofisica Espacial y Fisica Fundamental.

EUV SPECTRAL FEATURES OF ACTIVE BINARIES **c89**

A. Gimenez and N. Correia *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with

Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 155-157 (For primary document see N93-23878 08-88)
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Synthetic spectra of several representative cases of cool active binaries as they should be observable with the different spectrographs on board the Extreme Ultraviolet Explorer (EUVE) mission are presented. A solar enhanced emission of the transition region and a hot thin plasma model for the corona were used together with a correction for the effect of interstellar extinction. ESA

N93-23905# Kayser Threde G.m.b.H., Munich (Germany).
ORFEUS: SCIENTIFIC TARGETS AND OPTICAL PERFORMANCE c89
R. Graue, D. Kampf, and H. Rippel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 159-160 (For primary document see N93-23878 08-88)
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ORFEUS (Orbital and Retrieval Far and Extreme Ultraviolet Spectrometer) is the first short term scientific space payload of the free flying and retrieval ASTRO-SPAS satellite scheduled to be launched in February 1993. The autonomous scientific mission is limited to 5-7 days. The main scientific objectives are cosmic targets with photospheric temperatures between 10,000 to 1,000,000 K. ORFEUS is a powerful combination of two alternatively operating spectrometers covering the far and extreme ultraviolet spectral range in a telescope with 4 m tube length and an aperture of 1000 mm. The required spectrometric high telescope resolution in the ultraviolet range (40 to 125 nm) exceeds the performance of previous comparable UV instruments by a factor of 30 and is opening a new window in the universe. ESA

N93-23906*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPECTRAL EVOLUTION DURING A COMPLEX GAMMA RAY BURST OBSERVED WITH BATSE c93
D. E. Gruber (California Univ., San Diego.), D. L. Band (California Univ., San Diego.), L. Ford (California Univ., San Diego.), J. L. Matteson (California Univ., San Diego.), C. L. Meegan, R. B. Wilson, G. J. Fishman, W. S. Paciesas (Alabama Univ., Huntsville.), G. N. Pendleton (Alabama Univ., Huntsville.), and B. Schaefer (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 161-162 (For primary document see N93-23878 08-88)
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More than 270 gamma ray bursts have been observed to date with the BATSE (Burst and Transient Source Experiment) aboard the Compton Gamma Ray Observatory. Many have a duration of 10 seconds or more and complex structure with multiple peaks or spikes. Complex bursts in the energy range 30 keV to 1 MeV were systematically analyzed to determine the relations between intensity and spectral shape, or hardness. The burst hardness rises and falls in during spikes, but somewhat earlier than the intensity. A simple correlation between intensity and hardness is, therefore, not observed: the intensity lags instead. Results from one burst which shows evidence for longer lags in longer spikes are reported. ESA

N93-23907# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
SOFT X RAY EMISSION FROM SUPERGIANT X RAY BINARIES DETECTED ON THE ROSAT ALL-SKY SURVEY c93
Frank Haberl, Tomaso Belloni, and Fotis Mavromatakis *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 163-164 (For primary document see N93-23878 08-88)
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The supergiant x-ray binaries 4U 1700-37 and Vela X-1 were detected during the Rosat all sky survey with an average count rate of about 1 count/sec. The x-ray spectra can be fitted with a Bremsstrahlung model with a temperature of 0.5 keV. The x-ray spectrum in the Rosat PSPC (Position Sensitive Proportional Counter) band is consistent with the soft component seen during a Ginga observation of 4U 1700-37. The survey light curve for both sources indicate an eclipse of the soft component which continues after eclipse egress of the hard x-ray source. The low absorption of the soft component suggests that it originated far out in the stellar wind. ESA

N93-23908# Observatoire de Paris-Meudon (France).
SETI IN EUROPE c55
Jean Heidmann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 165-166 (For primary document see N93-23878 08-88)
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The contribution to SETI (Search for Extraterrestrial Intelligence) and to bioastronomy by European workers is evaluated. It reaches the level of 24 percent of the total international input. Contributors are France, Austria, and Italy. Europe contributes most to SETI strategies. France is the sole contributor to real searches and Italy has search projects. ESA

N93-23909# Ceskoslovenska Akademie Ved, Ondrejov. Astronomical Inst.
GROUND-BASED OPTICAL SUPPORT FOR GAMMA RAY SATELLITE ACTIVITIES c14
R. Hudec and P. Pravec *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 167-169 (For primary document see N93-23878 08-88)
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A program of ground based optical observations supporting gamma ray and x-ray space activities is presented. The idea is to provide inexpensive simultaneous or quasisimultaneous optical data with photographic and charge coupled devices. The photographic patrol network is described and its main advantages for x-ray and gamma ray astronomy are summarized. GRO (Gamma Ray Observatory) immediate follow up studies are described. ESA

N93-23910# Bremen Univ. (Germany). Center of Applied Space Technology and Microgravity.
ANALYSIS OF THE RESULTS OF THE FIRST YEAR OF OPERATION OF THE MUNICH DUST COUNTER c90
H. Iglseder, E. Gruen (Max-Planck-Inst. fuer Kernphysik, Heidelberg, Germany.), R. Muenzenmayer (Technische Univ., Munich, Germany.), H. Svedhem (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), and A. Huedepohl (BMW Rolls-Royce AeroEngines G.m.b.H., Lohhof, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 171-172 (For primary document see N93-23878 08-88)
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The Munich Dust Counter (MDC) is a scientific space experiment on board the Japanese satellite Hiten (Muses-A). The plasma, that is generated by the impact of cosmic dust particles in a target, is measured to determine mass, velocity, and crude flight direction of cosmic dust particles. The experiment setup and the satellite mission are described and the results of the first year of operation of the MDC are presented. From these particle measurements, preliminary results were derived, describing the cosmic dust flux versus time, particle velocity, and mass. These results were analyzed in more detail using the calibration data in order to discuss the spatial distribution and the directional distribution indicating the different populations of cosmic dust, apex particles, and pro and retrograde beta-meteoroides. ESA

N93-23911# Sao Paulo Univ. (Brazil). Inst. Astronomico e Geofisico.
GX301-2/WRA9777 REVISITED: PROBING THE STELLAR WIND THROUGH X RAY OPTICAL DATA c90
E. Janot-Pacheco *In* ESA, Environment Observation and Climate Modelling

Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 173-174 (For primary document see N93-23878 08-88)
(Grant CNPQ-301050/88-0(RN))
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An eccentric, massive x-ray binary provides a singularly favorable opportunity to probe the stellar wind of the blue supergiant companion star: the velocity profile can be derived with the help of the x-ray luminosity and of the rate of mass loss from the primary. Optical spectroscopic observations and contemporary x-ray measurements are used to estimate the acceleration of the wind of WRA 977. The mass loss rate along the orbit is deduced from H beta P Cyg profiles. Data from 1977 indicate a velocity law considerably slower than that predicted by radiation driven model. ESA

N93-23912# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.

THE INFRARED SPACE OBSERVATORY (ISO) **c14**

A. Salama and M. F. Kessler *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 175-176 (For primary document see N93-23878 08-88)
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The Infrared Space Observatory (ISO) will operate at wavelengths from 2.5 to 200 micrometers. ISO will provide astronomers with a unique facility of unprecedented sensitivity for a detailed exploration of the universe, ranging from objects in the solar system right out to sources at cosmological distances. The cryogenically cooled telescope will be equipped with four scientific instruments, which together will permit photometric, spectroscopic, and polarimetric observations as well as imaging. In keeping with ISO's role as an observatory, two thirds of its observing time will be made available to the general astronomical community, via the submission and selection (by peer review) of proposals. The remaining time will be reserved for the groups who provide the instruments, for the mission scientists, and for the observatory team who conducts the scientific operations. ISO is scheduled to be launched in 1994 and will be operational for at least 18 months. ESA

N93-23913# Commissariat a l'Energie Atomique, Saclay (France). Service d'Astrophysique.

A2163: AN EXCEPTIONALLY HOT CLUSTER OF GALAXIES **c90**

M. Arnaud *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 177-178 (For primary document see N93-23878 08-88)
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The x-ray spectrum of the distant galaxy cluster A2163 (z = 0.203) was measured in the energy range 1 to 18 keV with the Ginga satellite. A combined analysis of these data with data previously obtained with the Einstein observatory is presented. The temperature and x-ray luminosity derived are exceptionally high compared to other clusters: kT = 13.9 keV, L(sub X)(2 to 10 keV) 6.3 x 10(exp 45) ergs/s, as well as the gas mass 9 x 10(exp 14) solar mass and binding mass 27 x 10(exp 14) solar mass. The implications of the existence of such a cluster for cosmological models of the formation of structure in the universe are discussed. ESA

N93-23914# Commissariat a l'Energie Atomique, Saclay (France). Astrophysics Dept.

THE OPTICAL COUNTERPARTS OF THE X RAY BINARIES IN NGC 6712 AND 47 TUCANAE **c89**

Lydie Koch-Miramond and Michel Auriere (Observatoire du Pic-du-Midi, Bagneres de Bigorre, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 179-180 (For primary document see N93-23878 08-88)
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Photometric and spectroscopic observations in the error box for the x-ray burster X1850-086 in NGC 6712, obtained with the New Technology Telescope at the European Southern Observatory (La Silla), in excellent seeing conditions, are presented. For the first time with an homogeneous set of observations, it is shown that the star, called S, located at about 0.8 arcsec from the x-ray/radio source position, is a UV object with: B = 21.2 + or - 0.2, U-B = -0.8 + or - 0.3 and B-V = 0.2 + or - 0.5. Its dereddened colors and x-ray to optical luminosity ratio fit those of a Low Mass X-Ray Binary (LMXRB) and thus NGC 6712:S has to be considered as the optical counterpart of X1850-086. The absolute magnitude of NGC 6712:S is as faint as M(sub v) = 5.6 + or - 0.5 and this object is thus confirmed to belong to the class of compact LMXRB underluminous in the optical. The star S was monitored in the U passband during 4 hours 35 minutes and dimming of the star by about 0.4 mag, at the 3 sigma level, was observed. Two 30 minute long slit spectra with S in the aperture do not show any prominent spectral features characteristic of LMXRB apart a possible filling of the H beta absorption line. ESA

N93-23915# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

THE ROSAT ARCHIVE **c89**

Helmut Koehler, Achim Bohnet, and Joachim Paul *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 181-182 (For primary document see N93-23878 08-88)
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Rosat is an orbiting astronomical observatory sensitive in the 0.02 to 2.4 keV energy range (XUV and X-ray regime). The Rosat archive keeps the raw and auxiliary data and data products from the Standard Analysis Software System (SASS) as well as other evaluation products. The Rosat archival and retrieval system consists of a set of subsystems and utilities. The two main features are the archival subsystem and the retrieval subsystem. The principle of archiving is the storage of data trees rather than files, that is hierarchical structures of directories, subdirectories, and files. Optical disks are the prime storage media. The access criteria are the grouping of data called project and a keyword, which describes the type of data. One objective of an archival system is the easy retrieval. This is achived by sorting the file sets in different archive volumes. The whereabouts, size etc. of the data are kept in the archive catalog of the relational database INGRES. On retrieval these saved sets are unpacked and copied back to a user disk or the so called archive pool, a set of disks with 'Read' access for the user. ESA

N93-23916# Dornier System G.m.b.H., Friedrichshafen (Germany).

ROSAT: THE GERMAN X RAY SATELLITE NEARLY TWO YEARS IN ORBIT **c89**

H. Konstanski and E. Bachor *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 183-185 (For primary document see N93-23878 08-88)
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The German x-ray satellite Rosat serves as a spaceborne observatory for cosmic x-rays. Since its launch 1 Jun. 1990, it has gained precious data and extended the picture of the Universe. As Rosat has now reached its initially designed lifetime of 1.5 years, a short summary of its mission is given from the technical point of view. The technical results allow continuation of the successful Rosat mission. ESA

N93-23917# Landessternwarte auf dem Koenigstuhl, Heidelberg (Germany).

ROSAT OBSERVATIONS IN STAR FORMING REGIONS **c89**

J. Krautter, J. M. Alcala (Instituto Nacional de Astrofisica, Opyica y Electronica, Tonantzintla, Mexico.), J. H. M. M. Schmitt (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany.), R. Wichmann, H. Zinnecker (Wuerzburg Univ., Germany.), P. Predehl (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany.), M. Sterzig (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany.), R. M. Wagner (Ohio State Univ., Columbus.), and R. Mundt (Max-Planck-Inst. fuer Astronomie, Heidelberg, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 187-188

(For primary document see N93-23878 08-88)
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An investigation to determine the number of WTTS (Weak line T Tauri Stars) and their spatial distribution, to study their physical properties, and to find possible differences between these parameters and the individual star forming regions is presented. An algorithm was used to cross correlate positions in the Simbad database with Rosat PSPC (Position Sensitive Proportional Counter). To identify the x ray sources without known optical counterparts, extensive spectroscopic observations were carried out. Results show that the WTTS are distributed over a much larger area than classical TTS, which tend to be concentrated near the cloud cores. This indicates that the WTTS may be useful in tracing the history of star formation in star forming regions, although the sample of WTTS is as yet too small to draw any further conclusion. ESA

N93-23918# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Planetary and Space Science Div.
CASSINI/HUYGENS: A MISSION TO SATURN AND TITAN c91
J.-P. Lebreton and D. L. Matson (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 189-194 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The Cassini/Huygens mission is designed to explore the Saturnian system. The Cassini spacecraft comprises a NASA provided Saturn orbiter and an ESA supplied Titan atmospheric probe named Huygens. The scientific objectives of the mission are described and the main characteristics of the payload are provided. Since emphasis is on ESA's contribution to the mission, a detailed description of the Huygens probe mission phase is given and the major features of the probe design are discussed. An overview of the probe operations center is provided. ESA

N93-23919# Academy of Sciences, Potsdam (German D.R.). Astrophysikalisches Inst.
ASCHOT: ASTROPHYSICAL SCHMIDT ORBITAL TELESCOPE c89
H. Lorenz, G. M. Richter, K.-H. Schmidt, and H. M. Tovmasyan (Byurakan Observatory, Mount Aragatz, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 195-196 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The necessity for a wide angle UV space telescope for astrophysical investigations is outlined. Some of the main scientific goals such as full sky survey and the study of UV emission of extragalactic and galactic objects, which may be achieved by the use of the Astrophysical Schmidt Orbital Telescope (ASCHOT), are presented. The concept of the telescope design, its optical and the detector system, and its system of guidance are described. The limiting sensitivity of the telescope is estimated: it is about 24(sup m) for stellar objects at 1500 A. ESA

N93-23920# Universidad Autonoma de Madrid, Cantoblanco (Spain). Lab. de Astrofisica Espacial y Fisica Fundamental.
MULTIWAVELENGTH ANALYSIS OF STARBURST GALAXIES c90
J. Miguel Mas-Hesse and Miguel Cervino *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 197-198 (For primary document see N93-23878 08-88)
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A grid of evolutionary synthesis models for different scenarios (initial mass function slope, metallicity, age, etc.) and computing a set of observables in a wavelength range extending from soft x-rays to radio is reported. The model predictions were compared with observational data for a sample of 13 star forming galaxies of different morphologies, aiming to constrain the properties of the star formation episodes taking place there. The most relevant results found are the following: the slope of the IMF (Initial Mass Function) is not universal, varying in the range 1 to 3 in starburst galaxies; there is no correlation between IMF slope and metallicity of the environment in the sample; and the interstellar absorption follows a law similar to the SMC one in regions dominated by massive stars, independently on their metallicity. ESA

N93-23921# Athens Univ. (Greece). Space Physics Group.
ENERGETIC PARTICLE ACCELERATION AND PROPAGATION IN THE HELIOSPHERE c92
X. Moussas, Z. Theodossiou-Ekaterinidi (Siemens A.E., Athens, Greece.), J. J. Quenby (Imperial Coll. of Science and Technology, London, England.), P. L. Newman (Imperial Coll. of Science and Technology, London, England.), J. F. Valdes-Galicia (Universidad Autonoma de Madrid, Cantoblanco, Spain.), A. G. Drillia, D. Roulias, and A. Alevizos *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 199-200 (For primary document see N93-23878 08-88)
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Results from computer experiments based on high resolution interplanetary magnetic field and plasma data from spacecrafts Pioneer 10 and 11 are presented. Energetic particle acceleration and propagation play an important role in high energy astrophysics and especially to the origin of cosmic rays. Spacecraft measurements of cosmic rays and of the solar wind (plasma velocity and magnetic field) give a unique opportunity to study in situ these processes. The acceleration in realistic shocks and mean free paths at different heliodistances are computed. ESA

N93-23922# Dornier System G.m.b.H., Friedrichshafen (Germany).
CONCEPT OF A SMALL SATELLITE FOR URM c18
N. Pailer, G. Hampel, E. Bachor, H. Kunow (Kiel Univ., Germany.), and C. Bank (Euroavia, Stuttgart, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 201-203 (For primary document see N93-23878 08-88)
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The ideas and objectives behind a small scientific satellite for URM (Ulysses Reference Mission) are described. As a complementary element to the relatively big and complex missions there is a worldwide trend to small and ingenious missions. Particular interest was to probe the idea of a small complement to the big interplanetary mission Ulysses. The original idea within the former ISPM (International Solar Polar Mission) program was the simultaneous investigation of both solar poles with two solar probes (one from ESA and one from NASA). But in 1981 NASA stopped its contribution for cost reasons. Therefore the small satellite URM, carrying the five main Ulysses instruments on board, is supposed to compensate partly for the cancelled U.S. spacecraft by performing scientific baseline measurements. ESA

N93-23923# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
DESIGN AND IN ORBIT PERFORMANCE OF THE ROSAT PSPC c89
Elmar Pfeffermann and Ulrich G. Briel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 205-206 (For primary document see N93-23878 08-88)
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The Position Sensitive Proportional Counter (PSPC) is the prime focal plane instrument on board the X-ray astronomy satellite Rosat. It is a conventional multiwire counter, operating in an energy range from 0.1 to 2.4 keV. Its performance results in an energy resolution of delta E/E 0.41 FWHM, a position resolution of 230 micrometers FWHM and a quantum efficiency of 50 percent at 1 keV respectively. The background rejection capability in orbit of 99.85 percent was even higher than expected. Therefore the X-ray images have a high contrast, with a residual charged particle induced background as low as 0.000005 cts/s/sq arcmin/keV. The gain stability of the detector is very high, with a short time variation over one orbit of less than 1 percent and a long term gain drift over one month of 0.5 percent. The redundant PSPC, which is in operation since Jan. 1991, shows about the same performance. ESA

N93-23924# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.
FIRST: FAR INFRARED AND SUBMILLIMETER SPACE TELESCOPE **c89**
Goeran Pilbratt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 207-208 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The ESA FIRST (Far IR and Submillimeter Space Telescope) is described in terms of scientific objectives, science payload, spacecraft and mission design, and the current project schedule. FIRST is one of the four cornerstone missions in the 'Horizon 2000' long term ESA science program plan. FIRST will open up the last major, virtually unexplored, part of the electromagnetic spectrum, the submillimeter/FIR (1 mm (300 GHZ) to 0.1 mm (3000 GHZ = 3 THz)) range, which is almost totally unaccessible from ground based observatories because of the atmospheric blockage. ESA

N93-23925# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
X RAYING THE INTERSTELLAR DUST **c90**
Peter Predehl *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 209-210 (For primary document see N93-23878 08-88)
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The investigation of halos surrounding X-ray sources behind sufficiently dense dust columns provides an opportunity to separate the absorption and scattering components of interstellar extinction. The Rosat telescope, with the PSPC (Position Sensitive Proportional Counter), due to its very small mirror scattering and low background, is able to directly image dust scattering halos and determine the dust properties along the line of sight. X-ray scattering in dust particles and interstellar extinction are addressed and the gas to dust correlation is shown. ESA

N93-23926# Observatoire de Besancon (France).
EVIDENCE FOR TWO TYPES OF SOURCES CREATING HALLEY'S COMA **c90**
P. Rousselot, F. Vernotte, J. Clairemidi, and G. Moreels *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 211-212 (For primary document see N93-23878 08-88)
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Monochromatic composite images of Halley's coma in a 50 deg angular sector of radial extent 40,000 km are constructed in taking advantage of the spatial scanning capability of the Vega 2 three channel spectrometer. These images show the existence of two well contrasted jets which are identified in the solar dust scattered continuum as well as in the molecular emissions. The spatial distribution of dust scattered intensity in the UV at 377 nm and the visible at 482 nm are compared in computing an image of the I(sub 377)/I(sub 482) intensity ratio. The image shows that the ratio is slightly bluer in a region located between 10,000 and 25,000 km which appears as a result of jet spreading. The existence of a region connected with the jets where the color of dust is bluer is interpreted as the result of fragmentation of dust grains transported inside jets from the nucleus to distances of 10,000 to 25,000 km. The fragmentation processes would produce a local source of tiny submicronic particles of radius a less than 0.4 micrometers and would also be followed by a release of gas. The results presented provide a strong argument for the existence of an extended source connected with the jets. It is coherent with the detection of a CO source at 10,000 km by the Giotto NMS spectrometer 5 days later. ESA

N93-23927# Palermo Univ. (Italy). Dipt. Energetica e Applicazioni di Fisica.
SAX OVERVIEW **c89**
L. Scarsi (Consiglio Nazionale delle Ricerche, Palermo, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 213-217 (For primary document see N93-23878 08-88)
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Information is given concerning the satellite for X-Ray Astronomy SAX, a project of the Italian space agency in collaboration with the Netherlands agency for aerospace programs, due for launch at end 1993. The scientific objectives and the payload are described together with the ground system structure and organization. SAX is devoted to systematic, integrated and comprehensive studies of galactic and extragalactic X-ray sources in the energy band (0.1 to 300 keV); the observational goal to be addressed is to continue and expand upon previous spectral and timing observations of celestial sources in those areas for which the existing information is missing or inadequate and will remain uncovered in the forseeable future. ESA

N93-23928# Academy of Sciences, Potsdam (German D.R.).
NEARBY DWARF GALAXIES: DUST MASSES AND THEIR IMPLICATIONS **c90**
K.-H. Schmidt and T. Boller (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 219-220 (For primary document see N93-23878 08-88)
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About 40 percent of the galaxies in the extragalactic neighborhood have been identified with sources of the IRAS Point Source catalog. In most cases the infrared radiation is due to heated interstellar dust in the galaxies. The dust masses in dwarf systems have been estimated using simple models of dust clouds. There is no clear relation between the luminosity and the estimated dust mass of a galaxy. The gas to dust ratio in the interstellar medium of the dwarfs is more than one order of magnitude larger than in the interstellar medium of the Galaxy confirming the well known fact of low metal abundance in low luminosity systems. ESA

N93-23929# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
SEARCH FOR GAMMA RAY BURST SOURCES BY COORDINATED OBSERVATIONS FROM ULYSSES, GRO, AND PVO **c93**
M. Sommer and K. Hurley (California Univ., Berkeley.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 221-222 (For primary document see N93-23878 08-88)
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The measurement of gamma ray bursts by using interplanetary network and study of the morphology of light curves are discussed. Ulysses, now close to Jupiter, PVO, orbiting the planet Venus and CGRO, the Compton Gamma Ray Observatory near the Earth, all carry gamma ray burst detectors. The Ulysses detector, which is further away from the Earth than any previous burst detector is sensitive to 2 to 150 keV X-rays and with time resolution down to 8 ms. By the time of arrival method more than 12 gamma ray bursts were detected by three widely separated detectors and can be localized with high accuracy depending on the location of the various spacecraft. ESA

N93-23930# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
THE ROSAT STANDARD ANALYSIS SOFTWARE SYSTEM **c61**
Wolfgang Voges, Rainer Gruber, Joachim Paul, Klaus Bickert, Achim Bohnet, Jirina Bursik, Konrad Dennerl, Jakob Englhauser, Gisela Hartner, and Winfried Jennert et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 223-224 (For primary document see N93-23878 08-88)
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The Rosat X-ray astronomy satellite was launched 1 Jun. 1990 into a circular orbit with an inclination of 53 degrees and an altitude of 580 km. After an initial 2 month verification and calibration phase, Rosat began the first all sky X-ray survey in the soft X-ray (0.07 to 2.4 keV; 100 to 5 A)

and the extreme ultraviolet (0.025 to 0.2 keV; 500 to 60 A) bands using imaging telescopes. The first analysis of the six month survey is complete; about 60,000 new X-ray and 400 new XUV sources were detected. In Feb. 1991 pointed observations proposed by guest observers began. By the end of 1991 more than 1000 individual targets had been observed. The Rosat Standard Analysis Software System (SASS), set up to process all data from the survey and pointing phases, is described. ESA

N93-23931*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

SUMER: SOLAR ULTRAVIOLET MEASUREMENTS OF EMITTED RADIATION **c92**

K. Wilhelm (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany.), W. I. Axford (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany.), W. Curdt (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany.), A. H. Gabriel (Institut d'Astrophysique, Paris, France.), M. Grewing (Tuebingen Univ., Germany.), M. C. E. Huber (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), S. D. Jordan, M. Kuehne (Physikalisch-Technische Bundesanstalt, Berlin, Germany.), P. Lemaire (Institut d'Astrophysique, Paris, France.), and E. Marsch (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 225-226 Sponsored by BMFT/DARA; CNES; and PRODEX (For primary document see N93-23878 08-88)

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The experiment Solar Ultraviolet Measurements of Emitted Radiation (SUMER) is designed for the investigations of plasma flow characteristics, turbulence and wave motions, plasma densities and temperatures, structures and events associated with solar magnetic activity in the chromosphere, the transition zone and the corona. Specifically, SUMER will measure profiles and intensities of Extreme Ultraviolet (EUV) lines emitted in the solar atmosphere ranging from the upper chromosphere to the lower corona; determine line broadenings, spectral positions and Doppler shifts with high accuracy, provide stigmatic images of selected areas of the Sun in the EUV with high spatial, temporal and spectral resolution and obtain full images of the Sun and the inner corona in selectable EUV lines, corresponding to a temperature from 10,000 to more than 1,800,000 K. ESA

N93-23932# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.

INTEGRAL: INTERNATIONAL GAMMA RAY ASTROPHYSICS LABORATORY **c14**

Christoph Winkler *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 227 (For primary document see N93-23878 08-88)

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INTEGRAL is dedicated to the fine spectroscopy and imaging of celestial gamma ray sources in the energy range 15 keV to 10 MeV. The instruments on INTEGRAL will achieve a gamma ray line sensitivity of 3 times 10 to the minus 6th power ph/sq cm/s, a continuum sensitivity of 3 times 10 to the minus 8th power ph/sq cm/s/keV at 1 MeV (approximately 10 mCrab at 1 MeV) and imaging with an angular resolution of better than 20 minutes. This represents an order of magnitude improvement over the Gamma Ray Observatory (GRO) in line sensitivity, energy resolution and angular resolution. Comparison with the low energy gamma ray telescope Sigma also shows a major advance: the continuum sensitivity improvement is considerably more than one order of magnitude between 100 keV and 1 MeV; and the narrow line sensitivity is increased by nearly two orders of magnitude. INTEGRAL consists of two main instruments: a germanium spectrometer and a caesium iodide coded aperture mask imager. These instruments are supplemented by two monitors: an X-ray monitor and an optical transient camera. ESA

N93-23933# Academia Sinica, Kunming (China). Yunnan Observatory.

THE RELATION BETWEEN X RAY-SELECTED AND RADIO-SELECTED BL LAC OBJECTS **c89**

G. Z. Xie, Y. Y. Zhu, F. K. Liu, J. C. Wang, and Y. H. Zhang *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 229 (For primary document see N93-23878 08-88)

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Based on the orientation of relativistic jets of BL Lac objects, the observed apparent magnitude of 32 radio selected, and some of 43 X-ray selected BL Lac objects were corrected for Doppler effect. The corrected magnitude shows just as good a correlation with the correlational coefficient as previous results, which imply that the redshifts of BL Lac objects are cosmological. Other results obtained are: the uncorrected X-ray selected BL Lac objects fit the Hubble diagram well although their magnitudes were corrected because of the lack of relevant parameters; consistent with the fact that the X-ray selected BL Lac objects have jets with randomly oriented directions; the results show the average redshift $z = 0.23$ for X-ray selected BL Lac objects, and $z = 0.57$ for radio selected ones; four out of five BL Lac objects whose redshifts are very uncertain fit the Hubble diagram well. ESA

N93-23934# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

EXSAS: THE INTERACTIVE ANALYSIS SYSTEM FOR ROSAT DATA **c89**

H. U. Zimmermann, T. Belloni, G. Boese, C. Izzo, P. Kahabka, and O. Schwentker *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 231-232 (For primary document see N93-23878 08-88)

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EXSAS (Extended Scientifc Analysis System), based on the European Southern Observatory MIDAS image processing system, is a large software system for interactive analysis of X-ray and XUV data from the Rosat satellite. A multitude of typical applications and utilities in the areas of data preparation, correction of instrumental effects, spatial, spectral and timing analysis are implemented in a coherent context. EXSAS will normally be run interactively on workstations, but may also be used in batch mode. Some of the basic features and design criteria of the EXSAS/MIDAS environment that enable observers to effectively work with the system are listed. ESA

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N93-22381*# Hawaii Univ., Honolulu. Inst. for Astronomy.

STELLAR LYMAN ALPHA EMISSION AND THE LOCAL INTERSTELLAR MEDIUM Final Technical Report, 15 Nov. 1991 - 14 Nov. 1992

Theodore Simon 14 Nov. 1992 50 p

(Contract NAS5-30446; NAG5-146; NAG5-1823)

(NASA-CR-192635; NAS 1.26:192635) Avail: CASI HC A03/MF A01

Under the auspices of this ADP program, a systematic study was made of IUE archival images in order to extract spectra of the Lyman alpha region and to measure the stellar Lyman alpha flux for as many late-type stars as possible. The Lyman alpha resonance line is a powerful cooling channel for the hot chromospheres of solar-type stars, but has not been studied before in any systematic fashion across the H-R diagram. A major deterrent which has limited the use of Lyman alpha in the study of stellar chromospheres is the contamination of this spectral feature caused by the scattering of solar Lyman alpha photons in the Earth's exosphere. This scattered light is monochromatically imaged through the entrance slot of the IUE telescope and is superposed onto the stellar spectrum. In all but the shortest exposures with IUE, this 'geocoronal emission' overwhelms the stellar flux and makes it impossible to directly measure the strength of the stellar chromospheric feature. The IUESIPS processing contains no provision for correcting standard G.O. output products for this contamination. The first task was to develop a scheme for removing the geocoronal flux, specifically from low-dispersion spectra taken with the Short-Wavelength

Camera of IUE. The strategy adopted was to fit a 'sky model' to the spatially-resolved geocoronal emission observed through the large science aperture of the telescope, using the spectral orders on either side of the central ones where the stellar emission is concentrated. The model emission was then subtracted from the observed image, leaving behind the corrected stellar Lyman alpha emission. The details of this fitting procedure are described. Having devised a successful method for removing the unwanted geocoronal emission, the correction procedure was applied to 366 archival images which, from inspection of the photowrites in the IUE browse file, seemed especially promising. In this survey, Lyman alpha emission were eventually detected in the spectra of 227 stars representing a wide range in age, temperature, and luminosity throughout the cool half of the H-R diagram. Previously fewer than 30 such stars had been measured, and an order of magnitude increase in the numbers of stars having Lyman alpha flux measurements is provided. Multiple measurements were made for 52 stars and upper limits on chromospheric flux were derived for another 48 stars. Author (revised)

N93-22462 Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

ROSAT ALL SKY SURVEY OBSERVATIONS OF IRAS GALAXIES

T. Boller (Academy of Sciences, Potsdam, German D.R.), E. J. A. Meurs, W. Brinkmann, H. Fink, U. Zimmermann, and H.-M. Adorf (European Southern Observatory, Garching, Germany.) Mar. 1992 28 p Submitted for publication

(MPE-Preprint-220; ETN-93-93531) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Leopoldschafen-Eggenstein 2, Germany

A catalog of 244 IRAS galaxies positionally coincident with Rosat x-ray sources, which results from the correlation of a sample of 14708 extragalactic IRAS sources selected from the Point Source Catalog via statistical classification with the Rosat All Sky Survey, is presented. For 222 of them, optical counterparts could be identified by comparison with the NASA/IPAC Extragalactic Database. The sample of x-ray emitting IRAS galaxies comprises infrared luminous nearby galaxies, spirals and ellipticals, Seyfert galaxies, and Quasi Stellar Objects (QSO's). It is dominated by galaxies with active nuclei, unlike the sample of IRAS galaxies which have not been detected at x-ray wavelengths, at least in part due to the flux limitations of the Rosat survey. An unexpected result is the discovery of several spiral galaxies with luminosities up to 10 to the 43rd power erg/s, well above those found with the Einstein satellite. This suggests as a possible explanation that the x-ray luminous spirals are starbursts which are characterized by steep spectra and thus are more easily detected by Rosat. The x-ray properties are studied as a function of IR and optical fluxes for the different subgroups of galaxies in the sample. In general, a positive correlation is found between the x-ray luminosity and the IR and optical luminosities, respectively, which is steepest for Seyfert galaxies. The latter also appear to be separated from the other classes in correlations involving x-ray to IR or optical flux ratios. The x-ray to IR or optical flux ratios will be valuable for preselecting Seyfert galaxies when comparing x-ray to IR or optical surveys. By taking Seyfert galaxies into account, the trend of an increasing ratio f(sub x)/f(sub opt) with decreasing optical absolute magnitude, found for x-ray bright QSOs alone, is removed. ESA

N93-22665*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

NASA MARSHALL SPACE FLIGHT CENTER SOLAR OBSERVATORY REPORT, JULY TO DECEMBER 1992

J. E. Smith Washington Feb. 1993 89 p

(NASA-TM-108396; NAS 1.15:108396) Avail: CASI HC A05/MF A01

This report provides a description of the NASA Marshall Space Flight Center's Solar Vector Magnetograph Facility and gives a summary of its observations and data reduction during July-December 1992. The systems that make up the facility are a magnetograph telescope, an H-alpha telescope, a Questar telescope, and a computer code. Author

N93-23055*# National Aeronautics and Space Administration, Washington, DC.

REPORTS OF PLANETARY ASTRONOMY - 1991

Jurgen Rahe, ed. Mar. 1993 142 p

(NASA-TM-4459; NAS 1.15:4459) Avail: CASI HC A07/MF A02

This publication provides information about currently funded scientific research projects conducted in the Planetary Astronomy Program during 1991, and consists of two main sections. The first section gives a summary of research objectives, past accomplishments, and projected future investigations, as submitted by each principal investigator. In the second section, recent scientifically significant accomplishments within the Program are highlighted. Author

N93-23116# Ludwig-Maximilians-Univ., Munich (Germany). Fakultaet fuer Physik.

MAPPING THE UNIVERSE: STATISTICAL MEASURES OF THE GALAXY DISTRIBUTION Thesis

Houjun Mo Jun. 1991 212 p Sponsored by Max-Planck-Gesellchaft, and Academia of Sinica, China

(ETN-93-93456) Avail: CASI HC A10/MF A03

Statistical methods and their applications to study the large scale structures indicated by different objects, an important part of the mapping of the Universe, are addressed. From the observational data a number of statistical results that give constraints to the current models of galaxy formation are obtained. Theoretical models for the large scale structure formation in the Universe are summarized together with a number of catalogs that can be used for statistical purposes. During the study of the statistical methods for characterizing large scale structures special attention was given to the error analysis in these statistics. The angular two and three point correlation functions of the European Space Observatory (ESO)-Uppsala Catalog are estimated in angular diameter limited samples and the diameter function given by Lahar et al. is used to scale the results. The aim is to test the universality of some early results by using differently selected samples and samples formed in different regions. The morphological segragation of galaxies on large scales is analyzed together with the luminosity seggregation in the galaxy distribution. The large scale structure indicated by clusters of galaxies is then investigated using both the Abell and Zwicky catalogs. Outlook for future work is given. ESA

N93-23118# European Southern Observatory, Garching (Germany).

[ACTIVITIES REPORT OF THE EUROPEAN SOUTHERN OBSERVATORY] Annual Report, 1991

1992 129 p In ENGLISH; FRENCH; and GERMAN

(ETN-93-93459) Avail: CASI HC A07/MF A02

The dualities in European Southern Observatory's character brought about in part by the temporary but lengthy assignment to design and construct the Very Large Telescope (VLT) while operating La Silla (Chile), the world's largest optical/infrared observatory at the same time, are stressed in the introduction. Astronomical research performed in 1991 is reviewed. Activities of the European Coordination Facility or the Space Telescope (ST-ECF) are reviewed. These mainly concerned the support to users of cycle 1 and cycle 2 proposals, with the development of analysis tools and with the operation of the Hubble Space Telescope archive. Relations with Chilean authorities and image processing developments are considered. ESO conferences and workshops are listed. Work performed on telescopes since the choice of Paranal Peak near Antofagasta (Chile) as the site of the world's largest optical telescope is reported. The installation of the SEST bolometer, a general user instrument is addressed. Developments with other telescopes such as the NTT and with instrumentation of the VLT and the La Silla observatory are reported. Organizational, financial, and administrative matters are addressed. Appendices addressing the following are included: use of telescopes, programs, publications, and council and committee members. ESA

N93-23346# Astronomische Rechen-Inst., Heidelberg (Germany).

FIFTH FUNDAMENTAL CATALOGUE. PART 2: THE FK5 EXTENSION - NEW FUNDAMENTAL STARS

W. Fricke, comp., H. Schwan, comp., T. Corbin, comp., U. Bastian (Naval Observatory, Washington, DC.), R. Bien, C. Cole (Naval Observatory, Washington, DC.), E. Jackson (Naval Observatory, Washington, DC.), R. Jaehrling, H. Jahreiss, and T. Lederle et al Karlsruhe, Germany G. Braun G.m.b.H. 1991 145 p Sponsored in part by Heidelberg Univ.

(Rept-33(1991); ETN-93-93462) Avail: CASI HC A07/MF A02

The mean positions and proper motions for 3117 new fundamental stars essentially in the magnitude range about 4.5 to 9.5 are given in this FK5 extension. Mean apparent visual magnitude is 7.2 and is on average 2.5 magnitudes fainter then the basic FK5 which has a mean magnitude of 4.7. (The basic FK5 gives the mean positions and proper motions for

the classical 1535 fundamental stars). The following are discussed: the observational material, reduction of observations, star selection, and the system for the FK5 extension. An explanation and description of the catalog are given. The catalog of 3117 fundamental stars for the equinox and epoch J2000.0 and B1950.0 is presented. The parallaxes and radial velocities for 22 extension stars with large forecasting effects are given. Catalogs used in the compilation of the FK5 fundamental catalog are listed. ESA

N93-23455# Naval Research Lab., Washington, DC.
ASTEROID DETECTION AND MONITORING USING A SATELLITE-BORNE VISIBLE SCANNER
William A. Shaffer, Martin J. McHugh, and Dexter Wang 15 Jan. 1993 11 p
(AD-A259797; NRL/FR/5621-93-9538) Avail: CASI HC A03/MF A01

A satellite-borne visible scanner is proposed to continuously monitor the celestial sphere for near Earth asteroids. The proposed scanner uses the parallax motion of near Earth objects against a fixed background of distant objects. Image processing techniques will allow the detection of asteroids as small as 50 m in diameter at distances greater than 7 x 10(exp 6) km. This will give sufficient warning time against Earth intersecting asteroids. GRA

N93-23502*# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
STANDARDIZATION WORK FOR THE CALIBRATION OF INTENSITIES OF CELESTIAL OBJECTS *Final Report*
Arlo U. Landolt 16 Apr. 1993 3 p
(Grant NAGw-2911)
(NASA-CR-192831; NAS 1.26:192831) Avail: CASI HC A01/MF A01

Observations of celestial phenomena need to be calibrated, to be related, to some measurable quantity. There continues to be a long-term need for accurate photometric standard stars, those with known intensities and colors, so that brightness and color measurements made of various celestial phenomena by different observers can be integrated and compared with one another. Toward this end, the author has been emphasizing data collection in recent years for stars of 'intermediate' brightness, those approximately in the magnitude range 11.5 is less than V is less than 16.0. Photoelectric data were obtained at the Cerro Tololo InterAmerican Observatory's (CTIO) telescopes for stars in certain selected areas near the celestial equator. Stars of extreme color outside the selected areas, but near the equator, also were selected to provide a more broad and complete range in color index. It was proposed to complete the photoelectric phase of the program. The author proposed developing extremely faint sequences of photometric standard stars useful for both large space-based detectors and for land-based detectors. These data were to be collected via charge-coupled devices (CCD's) at telescopes located at CTIO and at the Las Campanas Observatory (LCO), both observatories being located in Chile. It was hoped that accurate data could be collected down to the 21st or 22nd magnitude. Author (revised)

N93-23720 Boston Univ., MA.
THE BOSTON UNIVERSITY-ARECIBO GALACTIC HI SURVEY: THE GALAXY AT 4 ARCMINUTE RESOLUTION Ph.D. Thesis
Thomas Andrew Kuchar 1992 304 p
Avail: Univ. Microfilms Order No. DA9236664

A new, high resolution survey of neutral atomic hydrogen (H I) emission has been conducted at the Arecibo Observatory. The survey investigated the thermal and kinematic properties of H I associated with objects of astronomical interest. The small beamwidth of the telescope (4') allowed the detection of absorption features and small scale structures that were unresolved in other large scale surveys. The survey consists of a 30 square degree map of the first galactic quadrant and smaller maps of 40 targeted objects. The first quadrant survey was used to examine the global kinematics of H I and the atomic properties for a subfield of molecular clouds. The spin temperatures and optical depths were determined for H I clouds seen in absorption toward H II regions (areas of ionized gas which surround young, hot stars). These temperatures appear strongly correlated with the measured optical depths. Kinematic distances were determined for 70 H II regions, 45 of which for the first time. A comparison between the Survey and other galactic-scale surveys can reveal additional physical properties of the interstellar medium. This was done in part by examining infrared emission from the H II region sample. The dust opacity and color temperatures were determined using data from the Infrared Astronomy Satellite. The luminosity distribution of the H II regions was calculated using the previously derived kinematic distances. One of the targeted fields was the Rosette Molecular Complex, a giant molecular cloud and a site of recent star formation. The total (atomic and molecular) mass of the complex was found to be 1.43 x 10(exp 5) solar mass of which 60 percent is in the atomic phase. The complex contains 30 molecular 'clumps' embedded in a low density gas. The clumps range from a few to several hundred solar masses and from 2 to 7 pc in diameter. An expanding shell, centered on the nebula, was detected in both the atomic and molecular gas. The dynamical age for the shell is approximately 4 million years, which is consistent with the age of the central star cluster NGC 2244.
Dissert. Abstr.

N93-23964 Ohio State Univ., Columbus.
THE COLD IONIZED SHELL AROUND THE OLD NOVA DQ HERCULIS Ph.D. Thesis
John Ellis Beaver 1992 167 p
Avail: Univ. Microfilms Order No. DA9238128

Long-slit spectra of the shell around DQ Her have been obtained using the Ohio State CCD spectrograph on the Perkins 1.8 m telescope of the Ohio State and Ohio Wesleyan Universities. The spectra, which spatially cover most of the shell, have relative flux-calibration and span the range 3500 A to 6690 A, at 10-A resolution. In addition, spectra at 2.5-A resolution, centered at H-alpha have been obtained for 11 position angles through DQ Her. The geometry of the shell can be determined kinematically if the near-degeneracy between the oblate and prolate cases (due to the high inclination) is resolved. A robust test for the symmetry axis is developed and it is shown that the prolate case is strongly favored. A prolate-spheroidal model is applied to the data and a distance of 520 plus or minus 30 pc is derived. The low-resolution spectra are binned into regions corresponding to the 'polar', 'equatorial', and 'tropical' bands seen in direct images. The slope of the Balmer continuum indicates a temperature of approx. 400 K for all three regions. The ratio H-alpha/H-beta is found to be roughly 3.6, in fair agreement with theory. (N I) lambda 5200 is found to be stronger at the equator, while the N II recombination lines are weaker. The spatial dependence of the ionizing radiation emitted by DQ Her, as implied by the level of ionization, is found to have an angle-dependence in agreement with that expected for a luminous accretion disk,. The implied flux toward the polar region is in agreement with an accretion disk model for m = 10(exp -17) g s(exp -1). The flux of (N II) lambda 6584 is observed to be roughly 0.4 H-beta for all three regions, in contrast to N II lambda 5005. It is concluded that collisional excitation in a warm component is partly responsible. The time-dependence, as the nebula expands, of this line is investigated with photoionization models, and it is concluded that only a small fraction of the gas is hot enough for collisional excitation. It is argued that models explicitly allowing for multiple density components are necessary to properly describe the basic features of this nebula.
Dissert. Abstr.

N93-24059# Real Inst. y Observatorio de la Armada, San Fernando (Spain).
CARLSBERG MERIDIAN CATALOGUE LA PALMA (SPAIN). NUMBER 6: OBSERVATIONS OF POSITIONS OF STARS AND PLANETS 1990
1992 252 p Prepared in cooperation with Copenhagen Univ., Denmark, and Royal Greenwhich Observatory, Cambridge, England
(ISBN-84-7469-052-8; ETN-93-93539) Avail: CASI HC A12/MF A03

Positions and magnitudes of 12,771 stars north of declination -45 deg, 11,555 proper motions, and 1,368 positions and magnitudes of 69 solar system objects obtained with the Carlsberg Automatic Meridian Circle on La Palma (Canary Islands) during the year 1990. The positions of the stars are for the epoch of observation and the equinox J2000.0, and are in a system close to that of the FK5. The limiting magnitude is m(sub v) = 14.8. The catalog mainly comprises the following stars: 4143 faint reference stars in a global net; 3162 International Reference Stars; 1040 faint reference stars in the fields of about 200 benchmark radio sources; 889 A5-G0 stars near the north galactic pole; 535 stars from an unbiased sample of K-M dwarfs; and 751 stars in nearby O-B associations. The catalog also contains observations of Callisto, Titan, Iapetus, Uranus, Neptune, Pluto, and 63 minor planets. The mean error of a catalog position in the zenith is 0.08 sec in right ascension and declination, and 0.04 min in magnitude. The mean error of the proper motions, derived by combining

the position in this catalog with those at earlier epochs, is typically 0.002 sec per year. Cross references are given to DM, AGK, SAO, HD, and the double star catalogs ADS and WDS. ESA

N93-24458*# Texas Univ., Austin. Dept. of Astronomy.
[INVESTIGATION OF SERENDIPITIOUS WFC SOURCES]
Edward L. Robinson 1 Mar. 1993 3 p
(Grant NAG5-1829)
(NASA-CR-192774; NAS 1.26:192774) Avail: CASI HC A01/MF A01

The serendipitious WFC sources under investigation, i.e., those which just happened to lie in the field of view while another object was being studied, were disappointing. The integration times were chosen to suit the primary target not the serendipitous targets. UX UMa, CZ Ori, BI Ori, WX Cet and AR And were not detected. A long (approximately 17 ksec) pointed observation of UX Uma (PI Wood) has since been carried out (February 1993) and the data is expected shortly. The other observations were much more successful. V471 Tau was observed with the WFC for 6.5 hrs with the S1 filter and 1.1 hrs with the S2b filter. It was easily detected with a count rate of 0.03 cps in the S1 filter and 0.15 cps in the S2b filter. The oscillations were seen, even before the data was folded, as was expected from preliminary results from the survey (Barstow et al. 1992). The pointed observations provide a much better phase coverage of the oscillations than did the survey data where the coverage was sparse. These data will be presented in a paper with the PSPC data (PI's Robinson and Shipman) and the pulse profiles in the different wavelengths will be compared. Author

N93-23880# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
THE ROSAT ALL-SKY X RAY SURVEY
Wolfgang Voges *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 9-19 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A03/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23881# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
OVERVIEW OF FIRST OBSERVATIONS WITH THE FRENCH TELESCOPE SIGMA ON BOARD GRANAT
P. Mandrou, J. P. Roques, G. Vedrenne, M. Niel, J. Paul (Commissariat a l'Energie Atomique, Saclay, France.), J. P. Leray (Commissariat a l'Energie Atomique, Saclay, France.), F. Lebrun (Commissariat a l'Energie Atomique, Saclay, France.), J. Ballet (Commissariat a l'Energie Atomique, Saclay, France.), E. Churazov (Academy of Sciences, USSR, Moscow.), and M. Gilfanov (Academy of Sciences, USSR, Moscow.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 21-26 (For primary document see N93-23878 08-88)
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N93-23883# Hamburger Sternwarte G.m.b.H. (Germany).
GRAVITATIONAL LENSES
Sjur Refsdal *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 37-40 (For primary document see N93-23878 08-88)
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N93-23884# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
ROSAT OBSERVATIONS OF SUPERNOVA REMNANTS AND THE INTERSTELLAR MEDIUM
Bernd Aschenbach *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 41-48 (For primary document see N93-23878 08-88)
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N93-23888# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
ROSAT OBSERVATIONS OF ACTIVE GALACTIC NUCLEI
Henner H. Fink *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 77-87 (For primary document see N93-23878 08-88)
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N93-23889# Space Telescope Science Inst., Baltimore, MD.
SOLAR SYSTEM OBSERVATIONS WITH HST
Francesco Paresce (European Space Agency, Paris, France.) and Jean-Claude Gerard (Liege Univ., Belgium.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 91-94 (For primary document see N93-23878 08-88)
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N93-23891*# Johns Hopkins Univ., Laurel, MD. Center for Astrophysical Sciences.
REVIEW OF RESULTS FROM THE HOPKINS ULTRAVIOLET TELESCOPE ABOARD THE ASTRO-1 MISSION
A. F. Davidsen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 105-110 (For primary document see N93-23878 08-88)
(Contract NAS5-27000)
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N93-23892# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
OBSERVATION OF THE EXTRAGALACTIC X RAY BACKGROUND
Guenther Hasinger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 111-117 (For primary document see N93-23878 08-88)
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N93-23894# European Southern Observatory, Garching (Germany).
ARCHIVAL AND ANALYSIS OF HUBBLE SPACE TELESCOPE DATA
R. Albrecht (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), F. Pasian, and B. Pirenne *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 127-131 (For primary document see N93-23878 08-88)
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N93-23895# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.
THE IUE ARCHIVE(S)
Michael Barylak and Daniel Ponz *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 133-136 (For primary document see N93-23878 08-88)
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N93-23896# European Southern Observatory, Garching (Germany).
DATA ANALYSIS AND ARCHIVES IN ASTRONOMY: A PERSPECTIVE VIEW
B. Benvenuti (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 137-138 (For primary document see N93-23878 08-88)

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N93-23897# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
IRAS GALAXIES IN THE ROSAT SURVEY
T. Boller, E. J. A. Meurs, M. Dennefeld (Institut d'Astrophysique, Paris, France.), W. Brinkmann, H. Fink, U. Zimmermann, and H.-M. Adorf (European Southern Observatory, Garching, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 139-140 (For primary document see N93-23878 08-88)
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N93-23898# Institute of Physical and Chemical Research, Saitama (Japan). Cosmic Radiation Lab.
X RAY SPECTRAL STRUCTURE OF THE SEYFERT 2 GALAXY NGC 5506
I. A. Bond, M. Matsuoka, and M. Yamauchi *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 141-142 (For primary document see N93-23878 08-88)
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N93-23902# European Southern Observatory, Garching (Germany).
HST IMAGING OF THE BINARY PULSAR PSR1913+16
Philippe Crane *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 149-151 (For primary document see N93-23878 08-88)
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N93-23904# European Space Agency. ESA Tracking Station, Madrid (Spain). Lab. de Astrofisica Espacial y Fisica Fundamental.
EUV SPECTRAL FEATURES OF ACTIVE BINARIES
A. Gimenez and N. Correia *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 155-157 (For primary document see N93-23878 08-88)
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N93-23905# Kayser Threde G.m.b.H., Munich (Germany).
ORFEUS: SCIENTIFIC TARGETS AND OPTICAL PERFORMANCE
R. Graue, D. Kampf, and H. Rippel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 159-160 (For primary document see N93-23878 08-88)
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N93-23914# Commissariat a l'Energie Atomique, Saclay (France). Astrophysics Dept.
THE OPTICAL COUNTERPARTS OF THE X RAY BINARIES IN NGC 6712 AND 47 TUCANAE
Lydie Koch-Miramond and Michel Auriere (Observatoire du Pic-du-Midi, Bagneres de Bigorre, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 179-180 (For primary document see N93-23878 08-88)
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N93-23915# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
THE ROSAT ARCHIVE
Helmut Koehler, Achim Bohnet, and Joachim Paul *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 181-182 (For primary document see N93-23878 08-88)
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N93-23916# Dornier System G.m.b.H., Friedrichshafen (Germany).
ROSAT: THE GERMAN X RAY SATELLITE NEARLY TWO YEARS IN ORBIT
H. Konstanski and E. Bachor *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 183-185 (For primary document see N93-23878 08-88)
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N93-23917# Landessternwarte auf dem Koenigstuhl, Heidelberg (Germany).
ROSAT OBSERVATIONS IN STAR FORMING REGIONS
J. Krautter, J. M. Alcala (Instituto Nacional de Astrofisica, Opyica y Electronica, Tonantzintla, Mexico.), J. H. M. M. Schmitt (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany.), R. Wichmann, H. Zinnecker (Wuerzburg Univ., Germany.), P. Predehl (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany.), M. Sterzig (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany.), R. M. Wagner (Ohio State Univ., Columbus.), and R. Mundt (Max-Planck-Inst. fuer Astronomie, Heidelberg, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 187-188 (For primary document see N93-23878 08-88)
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N93-23919# Academy of Sciences, Potsdam (German D.R.). Astrophysikalisches Inst.
ASCHOT: ASTROPHYSICAL SCHMIDT ORBITAL TELESCOPE
H. Lorenz, G. M. Richter, K.-H. Schmidt, and H. M. Tovmasyan (Byurakan Observatory, Mount Aragatz, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 195-196 (For primary document see N93-23878 08-88)
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N93-23923# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
DESIGN AND IN ORBIT PERFORMANCE OF THE ROSAT PSPC
Elmar Pfeffermann and Ulrich G. Briel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 205-206 (For primary document see N93-23878 08-88)
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N93-23924# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.
FIRST: FAR INFRARED AND SUBMILLIMETER SPACE TELESCOPE
Goeran Pilbratt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 207-208 (For primary document see N93-23878 08-88)
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N93-23927# Palermo Univ. (Italy). Dipt. Energetica e Applicazioni di Fisica.
SAX OVERVIEW
L. Scarsi (Consiglio Nazionale delle Ricerche, Palermo, Italy.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 213-217 (For primary document see N93-23878 08-88)
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N93-23933# Academia Sinica, Kunming (China). Yunnan Observatory.
THE RELATION BETWEEN X RAY-SELECTED AND RADIO-SELECTED BL LAC OBJECTS
G. Z. Xie, Y. Y. Zhu, F. K. Liu, J. C. Wang, and Y. H. Zhang *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 229 (For primary document see N93-23878 08-88)
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N93-23934# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
EXSAS: THE INTERACTIVE ANALYSIS SYSTEM FOR ROSAT DATA
H. U. Zimmermann, T. Belloni, G. Boese, C. Izzo, P. Kahabka, and O. Schwentker *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 231-232 (For primary document see N93-23878 08-88)
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90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics*.

N93-22403# Los Alamos National Lab., NM.
NEAR-EARTH OBJECT INTERCEPTION WORKSHOP SUMMARY
G. H. Canavan and J. Solem 27 Oct. 1992 23 p Presented at the Near Earth Objects Workshop, Los Alamos, NM, Oct. 1992
(Contract W-7405-eng-36)
(DE93-003793; LA-UR-92-3647; CONF-9210237-1) Avail: CASI HC A03/MF A01

A workshop at Los Alamos in January 1992 evaluated the issues involved in intercepting celestial objects approaching the Earth. It covered the technologies for acquiring, tracking, and homing on them, as well as those for interceptors to inspect, rendezvous with, land on, irradiate, deflect, or destroy them. This report records the presentation and technical options reviewed. DOE

N93-22469*# Arizona Univ., Tucson.
A JOINT PROGRAM WITH JAPANESE INVESTIGATORS TO MAP CARBON 2 LINE EMISSION FROM THE GALAXY Final Technical Report, 1 Jan. 1991 - 31 Dec. 1992
Frank J. Low and Tetsuo Nishimura 29 Mar. 1993 8 p
(Grant NAGw-2489)
(NASA-CR-192704; NAS 1.26:192704) Avail: CASI HC A02/MF A01

A large portion of the inner galactic plane has been mapped in the far-infrared (C II) line using a balloon-borne survey instrument. Complete coverage is reported from 25 degrees north to 80 degrees south of the galactic center and extending a few degrees on each side of the plane. Effective resolution is 14.1 acrmin (FWHM) and contour levels begin at 2 E -5 ergs/(s x sq. cm x ster). When compared with 100 micron dust emission observed by IRAS the (C II) appears well correlated with the dust emission except for a 10 degree region centered on the galactic center where emission from the gas is much weaker than that from the dust. Author

N93-22507# Texas Univ., Austin. Inst. for Fusion Studies.
HAMILTONIAN STRUCTURE OF THE VLASOV-EINSTEIN SYSTEM AND THE PROBLEM OF STABILITY FOR SPHERICAL RELATIVISTIC STAR CLUSTERS
H. E. Kandrup (Florida Univ., Gainesville.) and P. J. Morrison Nov. 1992 73 p
(Contract DE-FG05-80ET-53088)
(DE93-006180; DOE/ET-53088/585; IFSR-585) Avail: CASI HC A04/MF A01

The Hamiltonian formulation of the Vlasov-Einstein system, which is appropriate for collisionless, self-gravitating systems like clusters of stars that are so dense that gravity must be described by the Einstein equation, is presented. In particular, it is demonstrated explicitly in the context of a 3 + 1 splitting that, for spherically symmetric configurations, the Vlasov-Einstein system can be viewed as a Hamiltonian system, where the dynamics are generated by a noncanonical Poisson bracket, with the Hamiltonian generating the evolution of the distribution function f (a noncanonical variable) being the conserved ADM mass-energy H(sub ADM). An explicit expression is derived for the energy (delta(exp 2))H(sub ADM) associated with an arbitrary phase space preserving perturbation of an arbitrary spherical equilibrium, and it is shown that the equilibrium must be linearly stable if (delta(exp 2))H(sub ADM) is positive semi-definite. Insight into the Hamiltonian reformulation is provided by a description of general finite degree of freedom systems. DOE

N93-23065 Washington State Univ., Pullman.
MODEL ATMOSPHERES FOR LOW TEMPERATURE, HELIUM-RICH WHITE DWARFS: PROBLEMS WITH THE EQUATION OF STATE Ph.D. Thesis
Eric Roger Peterson 1992 189 p
Avail: Univ. Microfilms Order No. DA9239482

The Hummer-Mihalas equations are used to calculate an equation of state appropriate for low temperature, helium-rich white dwarfs. These equations take into account non-ideal gas effects, most importantly pressure ionization. New thermodynamic properties and opacities of two mixtures are calculated and used to construct model atmospheres for DZ stars with effective temperatures ranging from 4000 K to 7000 K. A temperature reversal is found to occur in the optically thin outer layers. The pressure ionization of Ca, Mg, and Fe is also found to occur already at small optical depths. This indicates that the abundances of these elements in stars like van Maanen 2 may be larger than previously believed. This could be important for the accretion hypothesis generally believed to explain the origin of heavy elements in DZ stars. Exploratory synthetic spectra are calculated for van Maanen 2. Dissert. Abstr.

N93-23095*# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
NEUTRAL GAS IN THE CENTRAL 2 PARSECS OF THE GALAXY
J. M. Jackson (Boston Univ., MA.), N. Geis (California Univ., Berkeley.), R. Genzel, A. I. Harris, S. C. Madden, A. Poglitsch, G. J. Stacey (California Univ., Berkeley.), and C. H. Townes (California Univ., Berkeley.) Feb. 1992 49 p Submitted for publication Sponsored in part by Boston Univ.
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(NASA-CR-192801; NAS 1.26:192801; MPE-Preprint-217; ETN-93-93529)
Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Leopoldschafen-Eggenstein 2, Germany

Spectroscopic observations elucidating the spatial distribution, kinematics, and desity structure of atomic and molecular gas within about 2 pc from IRS16/SgrA* are presented. Measurements confirm the presence of a dense (n(H2) approximately 1,000,000/cu cm), clumpy molecular gas ring surrounding a short lived central cavity of much lower mean gas density. It appears that this ring consists of several distinct and probably short lived (less than or approximately equal to 1,000,000 years) gas streamers that result from accretion from the massive molecular clouds within 10 to 30 pc of the center toward the central gravitational potential. Within 1 pc of SgrA*, a large atomic cloud (approximately 300 solar mass) is found, that appears to be falling in from greater than 3 pc galactocentric distance into the central cavity. The northern and eastern 'arms' of ionized gas are very likely dense, bright rims at the surface of this atomic cloud that is now exposed to the intense ultraviolet radiation from the central few arcsec surrounding IRS16/SgrA*. Most of the characteristics of the spatial distribution of the various observed components of ionized, atomic, and molecular gas can now be understood as the result of the impact of 1,000,000 solar luminosity of UV radiation from IRS16/SgrA* in a number of infalling gas streamers. ESA

N93-23132 Ohio State Univ., Columbus.
A STUDY OF PROPERTIES OF DARK GALAXY HALOS IN A CDM UNIVERSE USING N-BODY COMPUTER SIMULATIONS Ph.D. Thesis
Tereasa Gail Brainerd 1992 138 p
Avail: Univ. Microfilms Order No. DA9238137

Using N-body simulations in which large dynamic ranges in mass and

length can be achieved simultaneously, the mass function, spatial correlation properties, and peculiar velocity field of dark matter galaxy halos were investigated as a function of environment. A standard cold dark matter (CDM) universe was assumed. Halos were identified using a friends-of-friends algorithm with linking parameters l = .1, 0.2 and 0.3. The mass function of l = 0.2 and 0.3 halos is well-fit by a power law of index -1 plus or minus 0.1 for 10(exp 10) M(solar) approximately less than M(halo) approximately less than 10(exp 13) M(solar). The mass function of l = 0.1 halos is well-fit by a power law of index approximately -1.1 to approximately -1.4. The Press-Schecter prediction is a poor fit to the numerical mass function. Below a mass scale of approximately 10(exp 11) to approximately 10(exp 12) M(solar), l = 0.2 halos are produced with the same efficiency in regions of high, low, and average background mass density. The formation of halos with M(halo) approximately greater than 10(exp 13) M(solar) is strongly biased toward regions of high mass density. From the two-point correlation function, xi(r), the linear bias model is a good description of the formation of l = 0.2 halos (on scales up to approximately 30h(exp -1 Mpc), but not the l = 0.1 and 0.3 halos. In a low normalization universe (1/sigma 8 = 2.5), high mass halos are more strongly clustered than low mass halos; in a high normalization universe (1/sigma 8 = 1.5), high and low mass halos are clustered to the same degree. All the power in xi(r) for l = 0.1 halos comes from halos in high density regions, and for the l = 0.2 and 0.3 halos, most of the power in xi(r) comes from halos in high density regions, but there is a contribution from halos in average density regions. High mass l = 0.2 and 0.3 halos are fair tracers of the major mass motions in the simulation, and their low mass counterparts are biased tracers. The larger the local background density, the larger is upsilon(rms) of the halos, but it is not straightforward to estimate a local suppression or enhancement in mass density from upsilon(rms). For 2.5h(exp -1) Mpc approximately less than r approximately less than 12.6h(exp -1) Mpc, the velocity correlation function for l = 0.2 halos at 1/sigma 8 = 0.2 agrees well with the velocity correlation function of spiral galaxies. Dissert. Abstr.

N93-23133 Washington Univ., Seattle.
THE RADIATION GASDYNAMICS OF PLANETARY NEBULAE Ph.D. Thesis
Adam Frank 1992 207 p
Avail: Univ. Microfilms Order No. DA9239448

Using a highly accurate numerical method developed specifically for this problem the violent hydrodynamics of interacting stellar winds (ISW) of planetary nebulae (PNe) are investigated. These models include a full treatment of the radiation transfer, ionization, and radiative heating and cooling. Our results display a rich variety of features which confirm and surpass previously published models. In one dimension we performed a number of simulations which take account of the evolution of the central star and its affect on the dynamics of the nebulae. 'Theoretical observations' of the model PN are calculated. These synthetic intensity profiles, kinematics and line ratios are then compared with real observations. In two dimensions we present model results which demonstrate that the interacting wind scenario can account for the wide range of observed morphologies. By projecting a spherically symmetric fast into a toroidal slow wind the range of elliptical, bipolar and peanut shaped PN can be recovered. Consideration of ionization effects and projection effects further strengthen the case for the ISW models ability to account for the observed properties of PNe.
Dissert. Abstr.

N93-23194 York Univ. (England).
LATITUDINALLY PERIOD-DEPENDENT PULSATIONS: A MODEL OF THE DISTRIBUTED PERTURBATION IONOSPHERIC HALL CURRENT. THE RESULTANT GROUND FIELD AND A STUDY OF 3 INTERVALS Ph.D. Thesis
Ian Charles Krauklis 1991 273 p
Avail: Univ. Microfilms Order No. BRDX97546

The distributed ionospheric Hall current due to a transverse magnetic perturbation in the magnetosphere has been deduced for a simple model scenario. A vortex structure in the Hall current was generated and is a salient feature of a field line resonance (FLR). The latitudinal period dependency of a Pse could generate a similar structure in the absence of a transverse resonance. The model was used to simulate a pulsation observed on SABRE, good agreement was found between the modelled and observed data. The ground signal due to the Hall current was derived via the Biot Savart law. No period variation was observed on the ground when the coupling between the driving cavity/poloidal mode and the driven transverse mode was strong. A study has been made of 3 events with latitudinally period varying pulsations at plasmaspheric and plasmatrough latitudes. A number of FLR's was observed to contribute to the signature of a Pse. The period dependency in the plasmasphere tended to be an overlapping step like function centered on the FLR's. In the plasmatrough the coupling between the cavity/poloidal mode and the transverse model is less strong. The period variation is more continuous at these latitudes. For events with an azimuthal wavenumber /m/ greater than or equal to 3 the m = 0 decoupled solution of the hydromagnetic equation of motion in dipole coordinates is not valid.
Dissert. Abstr.

N93-23206# European Space Agency, Paris (France).
ATMOSPHERIC TRANSMISSION OF POLAR METEORITES
Philippe Bonny (Office National d'Etudes et de Recherches Aerospatiales, Paris, France.) Aug. 1992 240 p Transl. into ENGLISH of Transmission Atmospheriquedes Micrometeorites Polaires et Implications Original language document was announced as N92-20477
(ESA-TT-1283; ONERA-NT-1991-5; ETN-93-93519) Avail: CASI HC A11/MF A03

The current theory is reviewed, as concerns both the aerodynamic field and the material thermal reaction field, and a law governing the vaporization from a mixture of melted oxides is developed. The effect of an organic compound on heating and pyrolysis is analyzed accurately with a computer program that simulates the entire process of ablation of a charforming material. A program to simulate the complete micrometeorite atmospheric entry trajectory, including melting, porosity change, loss of an organic component and vaporization of the major elements of the mineral component was applied over the entire range of micrometeorite velocities and angles of entry. The entry corridor required for each of the three characteristics of the polar micrometeorites is evaluated. After weighting the angle and velocity allowed for each corridor, an entry velocity distribution compatible with actual polar micrometeorite characteristics is found by comparing computer generated data with 'experimental' data. The origin of polar micrometeorites and the part they may have played in bringing organic matter to the early Earth is discussed.
ESA

N93-23208 Washington State Univ., Pullman.
NITROGEN TO CARBON ABUNDANCE RATIOS DETERMINED FROM EMISSION LINES ORIGINATING IN TRANSITION LAYERS BETWEEN STELLAR CHROMOSPHERES AND CORONAE Ph.D. Thesis
Jose L. Mena-Werth 1992 196 p
Avail: Univ. Microfilms Order No. DA9239472

We explore the possibility of determining relative nitrogen to carbon abundances from the emission-line fluxes in the lower transition layers (30,000 K less than T less than 150,000 K) between stellar chromospheres and coronae. The surface fluxes of the transition layer emission lines are proportional to the emission measures E(sub m) and the element abundances A(el). Observations for main-sequence and luminosity class IV stars with presumably solar element abundances show that for the lower transition layers, i.e., for T less than 150,000 K, E(sub m) = BT(-gamma). This is also expected from theoretical considerations. We assume that this relation also holds for stars with nonsolar element abundance ratios. For a given carbon abundance, the constant gamma and B in this relation can then be determined from the C II and C IV emission-line fluxes. The emission measures are thus known for all temperatures between 30,000 and 150,000 K. Ratios of nitrogen to carbon abundances determined in this way for some giants and supergiants agree within the limits of errors with those determined by Luck, by Luck and Lambert, and by Lambert and Ries from molecular bands.
Dissert. Abstr.

N93-23210 Boston Univ., MA.
THE FORMATION, STRUCTURE, AND EVOLUTION OF PLASMOIDS Ph.D. Thesis
Mark Bela Santos Moldwin 1993 278 p
Avail: Univ. Microfilms Order No. DA9300031

The configuration and topology of the Earth's magnetotail is radically altered during geomagnetic substorms by the formation and subsequent ejection of large scale magnetic and plasma structures called plasmoids. The formation, structure, evolution and topology of plasmoids are studied by examining the magnetic and plasma data from the 1983 ISEE 3 Geotail Mission. This deep tail data set is combined with observations in the

middle tail by IMP 8, at geosynchronous orbit and from ground auroral magnetometer stations to develop a unified flux rope plasmoid model. It is found that plasmoids are highly correlated with geomagnetic substorms, are large (approximately 10-20 R(sub E)), rapidly tailward moving (approximately 500 km s(exp -1) magnetic flux rope structures, and are very stable (i.e., do not change size, downtail velocity, internal electron plasma energy density, or magnetic field signatures as a function of distance downtail). Evidence for the flux rope topology includes the strong correlation of the direction of the core magnetic field in the interplanetary magnetic field direction, the existence of plasmoids with various orientations with respect to the GSM xy plane, and the apparent mass flux of cool magnetosheath electrons into the structure as the plasmoid propagates downtail. Plasmoids are found to be a ubiquitous feature of the distant magnetotail and are occasionally observed in the relatively near-Earth tail by IMP 8. Due to the apparent large vertical extent of plasmoids, they affect the shape and size of the entire magnetosphere as the propagate downtail. Indirect observations of plasmoids are made in the plasma sheet boundary layer, the lobe, and the magnetosheath adjacent to the magnetopause. Because of their prevalence, size, velocity and magnetic and plasma energy content, plasmoids play an important role in the configuration, morphology, topology, and energy budget of the magnetosphere during geomagnetic substorms. Dissert. Abstr.

N93-23212 Texas Univ., Austin.
THE TWO BLACK HOLE PROBLEM IN 3+1 GENERAL RELATIVITY: ANALYTICAL APPROXIMATIONS AND NUMERICAL SOLUTIONS OF THE INITIAL DATA Ph.D. Thesis
Samuel Rocha Oliveira 1992 181 p
Avail: Univ. Microfilms Order No. DA9239324

This dissertation is concerned with the two body problem in general relativity. A simple analytical study is done for a static axisymmetric spacetime containing two black holes held at rest by a strut between them. Once we have the attractive force, obtained by calculating the compression force on the strut, we estimate the amount of gravitational radiation emitted for orbiting black holes and for two black holes in a head-on collision. We find good agreement with other estimates. The complexity of Einstein's equations for a general spacetime of two black holes leads us to the field of numerical relativity. In order to develop numerical tools for solving the dynamic part of Einstein's nonlinear equations, we study a head-on collision of two soliton solutions (a kink and an anti-kink) of a scalar field in a nonlinear self-potential. It has several qualitative similarities with a head-on collision of two black holes, both physically and numerically. The dynamics of the solitons, in particular whether or not the solitons coalesce, has a fractal dependence on the velocity of approximation. We explore this in detail. For the two black hole initial data we use York's conformal function approach combined with the two-sheeted-manifold isometry conditions to solve the constraint equations. We investigate some numerical algorithms to solve these constraints, which are non-linear elliptical equations, in order to find out fast and efficient algorithms for three-dimensional initial data. Two of the methods we study are finite elements and multiquadrics. We use a finite element method for axisymmetric configurations and a multiquadric method for fully general spatially three-dimensional configurations. Both methods are very appropriate for the boundary shapes of our problem. Finite elements require a lot of bookkeeping; the multiquadrics, on the other hand, require little bookkeeping. Thus the multiquadric method is easy to use in any number of dimensions. Nevertheless the multiquadrics still lack numerical analysis to tell us how to control the errors. Using both methods we reproduce existing axisymmetric solutions with good accuracy, and we have numerically solved the initial data constraint equations for a fully general three-dimensional configuration for two black holes using the multiquadric method. Dissert. Abstr.

N93-23214 Hawaii Univ., Honolulu.
THE SOURCE OF FIVE-MINUTE PERIOD PHOTOSPHERIC UMBRAL OSCILLATIONS Ph.D. Thesis
Matthew James Penn 1992 119 p
Avail: Univ. Microfilms Order No. DA9300343

Many types of velocity oscillations are observed in the umbrae and penumbrae of sunspots. We describe a project aimed at determining the source of one type of oscillation, the five-minute period photospheric umbra oscillations. The project uses imaging spectroscopy of spot umbrae, measuring the Doppler shift of pure umbral absorption lines to study the temporal and spatial properties of these oscillations. The Mees CCD (MCCD) instrument is an imaging spectroscopy device which uses the 25 cm coronagraph telescope and the 3.0 m coude spectrograph at Mees Solar Observatory (MSO) on Haleakala, Maui. The instrument works with resolving power up to R approx. 200,000 with significant throughput from lambda-3934 A (Ca II K) to lambda approx. 10000 A. A fast guiding active mirror stabilizes the image during observations. A rapidly writing magnetic tape storage system allows observations to be recorded at 256 Kbytes s(exp -1). We observed the oscillations in the umbrae of two sunspots using the MCCD imaging spectrograph. We observed the Doppler shifts of 18 molecular lines in the umbrae for roughly 50 hours in each spot during the interval of 11 to 16 May 1991. We find no simple correlation between the velocity measured with molecular lines and the velocity measured using two iron lines. We remove solar rotation, image drift, and interpolate all the data onto an even time grid. We perform four spatial analyses of the umbral velocity and find (1) there is more power traveling toward the center of the umbrae than leaving the center of the umbrae (this provides a direct measure of the absorption of p-modes by the sunspot umbrae), (2) the umbral oscillations have spatial and temporal characteristics indistinguishable from the quiet-sun oscillations, (3) a Fourier-Bessel analysis shows no obvious resonant frequencies which might represent natural oscillation modes of the sunspot umbrae, and (4) the centers of the umbrae have less RMS velocity than the edge of the umbrae. From these analyses we conclude that the photospheric umbral oscillations are driven by an external source and that source is the global p-mode oscillations. Dissert. Abstr.

N93-23218 Indiana Univ., Bloomington.
MAGNETIC FIELD STRUCTURE AND COLLECTIVE EFFECTS IN SUPERNOVA REMNANTS Ph.D. Thesis
Craig Alan Wood 1992 206 p
Avail: Univ. Microfilms Order No. DA9235312

Observations of the northeast rim of the intermediate age SNR IC 443 obtained at 20.9 cm with the VLA have resolved the bright filamentary clouds. The cloud size is inconsistent with the evaporation length of isolated filamentary clouds. By considering collective evaporative effects among filamentary clouds using an analogous electrostatic model, an evaporation length consistent with the observations is found. In order to investigate magnetic field structure, a method quantifying the degree of organization of the local magnetic field in a region is presented. This method is applied to data from high resolution polarimetric observations of the filamentary structure in the northeast rim of IC 443 obtained at 6.1 cm with the VLA. The local magnetic field is found in organized regions preferentially located within the rim and correlated with regions of relatively high polarized intensity. The size scale of the largest organized region associated with IC 443 is approximately 85 arcsec (0.6 pc), and the apparent size scale of local field organization of the ambient ISM is approximately 35 arcsec (0.25 pc). The direction of the mean field in regions of high local field organization of IC 443 is generally oriented neither parallel nor perpendicular to the rim. Significant polarized brightness extends over 0.5 pc beyond the rim of IC 443 defined by the total intensity and probably represents the outer shock of the SN blast. The method is next applied to VLA data from the young remnant of Tycho's supernova (3C 10), where it is also found that the local magnetic field is organized into regions correlated with regions of relatively high polarized intensity. The size scale of the largest organized region associated with 3C 10 is approximately 110 arcsec (1.33 pc), and the apparent size scale of the local field organization of the ambient ISM is approximately 30 arcsec (0.36 pc). The direction of the mean field in regions of high local field organization within rim of 3C 10 is generally radial. Dissert. Abstr.

N93-23231*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
ANALYSIS OF IUE OBSERVATIONS OF HYDROGEN IN COMETS Final Report
Michael R. Combi and Paul D. Feldman (Johns Hopkins Univ., Baltimore, MD.) Mar. 1993 23 p
(Contract NAS5-30450; NAG5-1333; NsG-5393)
(NASA-CR-192693; NAS 1.26:192693) Avail: CASI HC A03/MF A01

The large body of hydrogen Lyman-alpha observations of cometary comae obtained with the International Ultraviolet Explorer satellite has gone generally unanalyzed because of two main modeling complications. First, the inner comae of many bright (gas productive) comets are often optically thick to solar Lyman-alpha radiation. Second, even in the case of a small

comet (low gas production) the large IUE aperture is quite small as compared with the immense size of the hydrogen coma, so an accurate model which properly accounts for the spatial distribution of the coma is required to invert the inferred brightnesses to column densities and finally to H atom production rates. Our Monte Carlo particle trajectory model (MPTM), which for the first time provides the realistic full phase space distribution of H atoms throughout the coma was used as the basis for the analysis of IUE observations of the inner coma. The MCPTM includes the effects of the vectorial ejection of the H atoms upon dissociation of their parent species (H2O and OH) and of their partial collisional thermalization. Both of these effects are crucial to characterize the velocity distribution of the H atoms. A new spherical radiative transfer calculation based on our MCPTM was developed to analyze IUE observations of optically thick H comae. The models were applied to observations of comets P/Giacobini-Zinner and P/Halley. Author (revised)

N93-23390 Keele Univ. (England).
STUDIES OF COSMIC DUSTS USING SYNCHROTRON RADIATION Ph.D. Thesis
Stephen P. Thompson 1991 449 p
Avail: Univ. Microfilms Order No. BRDX97432

The structural characteristics of cosmic dusts and cosmic dust analogue materials are investigated using the Daresbury Laboratory synchrotron source. X-ray absorption spectroscopy is used to probe the local atomic environments of Fe and Ni atoms in iron meteorites and of Si atoms in heat treated synthetic Mg/Fe silicates and in commercially produced silicon carbide powders. Power diffraction (PD) is used to probe the long range order in matrix olivine samples from carbonaceous chondrite meteorite, silicon carbide polytypes, laboratory produced amorphous carbons and heat treated synthetic silicate samples. A 'restricted least squares convolution' procedure is developed to effect data smoothing and peak position identification via derivatives. The performance of this procedure and its relation to experimental parameters such as instrumental broadening are discussed in detail. Extended X-ray absorption fine structure (EXAFS) data are analyzed using both curved wave theory structural modelling and a novel technique of spectral synthesis. The latter is applied to iron meteorite EXAFS as a means of determining bulk Ni partitioning between BCC and FCC structural phases. Structural modelling is applied to both silicon carbide and synthetic silicate samples. The olivine 130 diffraction profiles of carbonaceous chondrite matrix materials are treated as being produced by olivine solid solutions, from which the percentage fosterite compositions are determined. PD features produced by amorphous carbon are interpreted in terms of microcrystalline graphite-like structure. PD is used to probe the evolution of crystalline structure within thermally processed synthetic Mg/Fe silicates. Dissert. Abstr.

N93-23491 Durham Univ. (England).
THE STELLAR POPULATIONS OF EARLY-TYPE GALAXIES IN GROUPS AND CLUSTERS Ph.D. Thesis
Richard Gwyn Bower 1990 225 p
Avail: Univ. Microfilms Order No. BRD-97364

This thesis investigates the relationship between the environment of an early-type galaxy and its stellar populations. Most importantly, we wish to determine whether the star formation histories of early-type galaxies depend on the density of the group or cluster to which they belong. This issue is of considerable consequence, as it provides a means to distinguish whether the early-type morphology of these systems is determined at their formation, or whether it is assumed at a later time due to the action of their changing surroundings. We have applied two methods to compare the stellar populations of these galaxies. Firstly, we have analyzed the strengths of surface gravity sensitive spectral lines in order to compare the relative contributions of dwarf and giant stars to the blue light. Several samples of E and SO galaxies, drawn from a wide variety of environments, have been measured with this technique. Secondly, we have made a precise comparison of the broad-band colors of early-type galaxies in the Coma and Virgo clusters. These clusters have very different average densities, and distinctly disparate mixtures of galaxy morphological types. The findings of these studies appear to be contradictory, however. Although the surface gravity analysis indicates that early-type galaxies in lower density regions contain more substantial populations of relatively young stars, the broad-band colors of galaxies in the Virgo and Coma clusters are indistinguishable. A third section of the thesis develops the Press-Schechter theory for the evolution of gravitational structure in an expanding universe. Our work allows us to compare the past histories of the environments of galaxies as a function of the mass of the group or cluster to which they presently belong. In the final chapter, we discuss how the results from these three areas of research relate to each other, and suggest two ways in which the apparent paradox of our observational work may be resolved. Considering the implications of our theoretical work leads us to review the fundamental differences between the 'nature' and 'nurture' scenarios for the origin of galaxy morphology. Dissert. Abstr.

N93-23596 Oxford Univ. (England).
AN EXPERIMENTAL STUDY OF THE POSSIBLE ASSOCIATION OF DEEP UNDERGROUND MUONS WITH ASTRONOMICAL POINT SOURCES Ph.D. Thesis
Mark Andrew Thomson 1991 204 p
Avail: Univ. Microfilms Order No. BRD-97301

A sample of 5.6 million muons, recorded at a depth of 2090 mwe in the Soudan 2 detector between January 1989 and June 1991, has been examined for evidence of excess fluxes from Cygnus X-3 and other astronomical point sources. Software has been developed which routinely processes and corrects the data in order to achieve the optimum angular resolution. The reconstructed muon directions have been verified by a comparison with independent measurements from the proportional-tube veto shield which surrounds the detector. The angular resolution has been measured, from a sample of events containing two near-parallel muons, to be 1 degree. The alignment of the detector has been checked by comparing the observed spatial distribution of underground muons to that expected from the topology of the rock. A consideration of both angular resolution and systematic effects led to the a priori choice of a 2 degree cone as the optimum search region for Cygnus X-3. No overall (DC) or phase-modulated excess was observed from the direction of Cygnus X-3 and a 90 percent confidence level upper limit of less than 1.2 x 10(exp -11) cm(exp -2) s(exp -1) can be placed on the steady flux. The data were also examined for any evidence of excess muon fluxes correlated with the large radio flares of Cygnus X-3. Significant muon excesses, corresponding to fluxes of 7 x 10(exp -11) cm(exp -2) s(exp -1), were observed on the 20th and 23rd January 1991. The probability that such a correlation occurred by chance is estimated to be 1 in 1000. This observation has been compared with the results from extensive air shower arrays and other underground experiments. The results from one surface experiment provide possible confirmation of the Soudan result. The flux of underground muons from the observed gamma ray flux has been estimated and cannot explain the Soudan 2 observation. Dissert. Abstr.

N93-23722 Cornell Univ., Ithaca, NY.
OBSERVATIONS AND MODELING OF THE DUST AND GAS IN AN ISOLATED DIFFUSE INTERSTELLAR CLOUD Ph.D. Thesis
David Lawrence Shupe 1992 130 p
Avail: Univ. Microfilms Order No. DA9236069

We present comprehensive radio, infrared, and optical observations of a diffuse interstellar cloud, and calculate the expected emission from interstellar grains. The cloud is unique in being relatively tenuous and very sharply defined both spatially and in velocity, and provides an almost ideal laboratory for study of the diffuse interstellar medium. We have mapped with high resolution the atomic gas in the cloud via the 21 cm line. The maximum H I column density is 4 x 10(exp 20) H-atom cm(exp -2). Our sensitive search for carbon monoxide emission yielded an upper limit on the integrated CO intensity of 0.036 K km s(exp -1), suggesting that little or no molecular material is present in the cloud. We present data on the cloud in the 12, 25, 60, and 100 micron bands from the Infrared Astronomical Satellite. The I(sub nu)(100)/N(sub H) ratio is 0.52 plus or minus 0.05 x 10(exp -14) Jy sr(exp -1) sq cm, comparable to previous surveys of lower spatial resolution. The I(sub nu)(60)/I(sub nu)(100) ratio is 0.32 plus or minus 0.03, about 50 percent larger than average values. The grain distribution in the cloud may have been modified by shocks. We have performed deep optical imaging in the B, V, R, and I bands, and have detected emission from the cloud at the level of 27-28 magnitudes per square arcsecond. The optical colors of the cloud show a slight excess in the R and I bands over predictions of a simple scattering model. This excess is not as large as that found in other investigations and may indicate that the particles responsible for excess red emission are severely dehydrogenated. We calculate the infrared emission from a grain model

including stochastically heated small particles. To match the flux distribution of the cloud, 20 percent or more of the grain mass must consist of 5 A grains. We also compute photoelectric gas heating from these models and find that it is comparable with other estimates of heating and cooling. A very recent observational upper limit on (C(sub II)) emission from the cloud falls in the middle of the heating estimates. Dissert. Abstr.

N93-23952# California Univ., Berkeley. Lawrence Berkeley Lab.
NEUTRON STARS, STRANGE STARS, AND THE NUCLEAR EQUATION OF STATE
F. Weber and N. K. Glendenning 2 Nov. 1992 28 p Presented at the Workshop on Nuclear Physics in the Universe, Oak Ridge, TN, 24-26 Sep. 1992
(Contract DE-AC03-76SF-00098)
(DE93-004704; LBL-33066; CONF-9209239-3) Avail: CASI HC A03/MF A01

This article consists of three parts. In part one the present status of dense nuclear matter calculations are reviewed, and a representative collection of realistic nuclear equations of state which are derived for different assumptions about the physical behavior of dense matter (baryon population, pion condensation, possible transition of baryon matter to quark matter) is introduced. In part two, recently performed non-rotating and rotating compact star calculations performed for these equations of state are reviewed. The minimum stable rotational periods of compact stars whose knowledge is of decisive importance for the interpretation of rapidly rotating pulsars are determined. For this purpose two different limits on stable rotation are studied: rotation at the general relativistic Kepler period (below which mass shedding at the star's equator sets in), and, secondly, rotation at the gravitational radiation-reaction instability (at which emission of gravitational waves set in which slows the star down). In part three, the properties of hypothetical strange stars are discussed. Specifically, the amount of nuclear solid crust that can be carried by a rotating strange star is investigated and the question of whether such objects can give rise to the observed phenomena of pulsar glitches, which is at the present time the only astrophysical test of the strange-quark-matter hypothesis is answered. DOE

N93-23961# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
CHAOTIC EVOLUTION OF THE SOLAR SYSTEM
Gerald J. Sussman and Jack Wisdom Mar. 1992 20 p
(Contract N00014-89-J-3202)
(AD-A260055; AI-M-1359) Avail: CASI HC A03/MF A01

The evolution of the entire planetary system for nearly 100 million years was studied using a computer with an integration technique. This calculation confirms that the evolution of the solar system as a whole is chaotic, with a remarkably short timescale of exponential divergence of about 4 million years. Additional numerical experiments indicate that the dynamical evolution of the Jovian planets is chaotic apart from the rest of the system as is the motion of Pluto. GRA

N93-23991 Oxford Univ. (England).
THE KINEMATICS OF STARS AND GAS IN THE GALACTIC DISK Ph.D. Thesis
Adrian Robin Jenkins 1992 120 p
Avail: Univ. Microfilms Order No. BRD-97293

The Fokker-Planck equation, which describes the heating of a stellar disk under the combined influence of stochastic spiral structure and giant molecular clouds is solved by Monte Carlo simulation. It is found that disk heating by these two agents can adequately account for the velocity dispersions of young stars. An independent estimate of the present day local value of the cloud heating parameter, which determines the heating of the disk by clouds, is consistent with the results. The RMS amplitude of the potential of the spiral waves is estimated to be: delta phi is approximately (11 - 15 kms(exp -1))(exp 2). To account for the velocity dispersion of the disk as a whole requires a very much higher value of the cloud heating parameter in the early disk; alternatively, the velocities of the oldest stars may have some other origin. In the simulations, the disk is treated, at first, as having a fixed harmonic potential. The use of a more realistic anharmonic potential leads to essentially similar results. The influence of adiabatic effects due to the evolution of the vertical potential of the disk is investigated by modelling the disk as a 1-dimensional self-gravitating layer. It is found that adiabatic heating due to accretion, steepens the age-velocity relation but does not lead to any peculiar signature in the velocity distribution. The distribution of the stellar vertical velocities is predicted to be very close to isothermal in a population with a constant birth-rate. The gas dynamics in a rotating barred potential designed to simulate the Galactic center, is modelled. The gas is represented by particles which interact inelastically with each other. The modelling concentrates on reproducing a prominent feature seen in longitude-velocity (l-v) plots of the Galactic center, which Binney et al. have suggested is due to gas transferring from chi(sub 1) to chi(sub 2) orbits. The feature caused by this transfer is examined in the simulated l-v plots for a set of different viewing angles and bar axis ratios. The feature is enhanced by marking particles according to their collision history. Particles which have been strongly shocked are assumed to be made of H2. For some viewing angles the simulated feature is similar to the observations though the real feature is considerably less symmetric.
Dissert. Abstr.

N93-24161 Illinois Univ. at Urbana-Champaign, Savoy.
MOTION OF CHARGED PARTICLES IN PULSAR MAGNETOSPHERES Ph.D. Thesis
Haris Andrea Zachariades 1992 192 p
Avail: Univ. Microfilms Order No. DA9236636

The motion of charges in the magnetosphere of pulsars is studied from two complementary points of view: (1) for the case of aligned magnetic and rotational axes we solve a fluid version of the Lorentz-Dirac equation, in the Landau approximation, for a two-component plasma. We start from an approximately force-free initial condition and numerically integrate the equations of motion for a time equal to 1.6 percent of one stellar rotation period. We find that the system tends to a charge-separated state in which a negative charge region above the poles is separated by a vacuum gap from a positive charge region near the equator. We see the formation of force-free regions and a tendency of the vacuum gap to spread as the integrations proceed. The energies attained by the charges are only mildly relativistic and radiation reaction does not play an important role during the integrations. The negative charge above the polar region is electrostatically bound and there is a force-free region towards which negative charge tends to flow. Some positive charge is magnetically confined near the stellar equator and other positive charge crosses magnetic field lines moving outward to the region beyond the light cylinder. The outward motion of positive charge is due to the relative magnitudes of the electric and magnetic fields. (2) For the case of non-aligned axes we study the single particle dynamics for electrons moving in the region beyond the light cylinder, again using the Landau approximation to the Lorentz-Dirac equation. The effect of the inner magnetosphere is taken into account by adding a central attractive charge. We find that there exists a class of solutions corresponding to bounded orbits beyond the light cylinder. In an independent particle picture, particles started with different initial conditions within the basin of attraction of this class of orbits eventually form corotating patterns beyond the light cylinder. For a frequently occurring particle configuration we find emission from radio to gamma-ray frequencies with a spectrum different than that of synchrotron radiation. We also show the existence of phase locked dynamics for this system. These results suggest a possible structure of the outer magnetosphere of a non-aligned pulsar.
Dissert. Abstr.

N93-24179 University Coll., Cardiff (Wales).
MID-INFRARED SPECTROSCOPY OF SOLIDS IN RELATION TO THE COMPOSITION OF INTERSTELLAR AND INTERGALACTIC DUST Ph.D. Thesis
Qasim S. Majeed 1990 261 p
Avail: Univ. Microfilms Order No. BRDX97472

The chemical and physical information on the composition and nature of interstellar grains is a long-standing problem in astrophysics. This information can, in principle, be determined from infrared observations of astronomical sources. Whilst a spectral feature near lambda = 3.4 micron can be assigned unambiguously to CH stretching in organic material, features near the wavelengths 10 and 20 microns are open to several interpretations. Alternative explanations fall into two broad categories: C-C, C-O and C-N stretching in organic grains on the one hand, and Si-O stretching in mineral grains on the other. However, detailed comparison between laboratory spectra of various crystalline and amorphous silicates and the features in several astronomical objects, including circumstellar dust shells around cool

stars, and in more extended sources as in the Trapezium nebula, are not satisfactory. In particular, silicates, whether they are of terrestrial or lunar origin, all show either too much structure or have their absorption peaks at the wrong wavelength. We obtained the infrared spectra of different organic, biological, and inorganic materials over the range 2.5-50 microns using a Perking-Elmer 783 series spectrophotometer. We compared these spectra with the 10 and 20 microns spectral features observed in objects in our galaxy and the external galaxies. A mixture of diatom silica with linked SiO4 tetrahedra together with organic grains characterized by the spectrum of an 'average' bacterium, provides excellent agreement with astronomical data relating to broad 10 and 20 microns emission and absorption features. Condensation of clay-like particles of radii 0.01 micron are most likely to occur in the atmospheres of Mira-type stars and be expelled by radiation pressure into interstellar space. These particles would tend to stick onto the surfaces of bacterial grains in conditions of high density associated with regions of star formation. The absorption and emission features at the 10 micron region of the circumstellar shell of cool carbon stars, OH/infrared sources, and the BN object, have been compared to that obtained from a composite model comprised of red crystal, diatom-silica, and 'average' bacteria. Good agreement between the astronomical data for these sources and the model has been obtained.

Dissert. Abstr.

N93-24180 Rice Univ., Houston, TX.
THE FORMATION OF ENHANCED, LOW-IONIZATION EMISSION IN GALACTIC HALOS Ph.D. Thesis
James Kurt Sokolowski 1992 225 p
Avail: Univ. Microfilms Order No. DA9234444

Recent observations have discovered pervasive, low-ionization gas with unusual excitation in the halos of nearby spiral galaxies. This has led to speculation concerning the excitation mechanisms operating at high galactic latitudes, including exotic processes involving nonequilibrium physics, local grain destruction and decaying dark matter. We demonstrate that the excitation conditions of the diffuse ionized media (DIMs) in several such objects, NGC 891, the Galaxy and NGC 1068, can be understood in terms of photoionization by the dominant radiation fields in their halos, if proper consideration is given to the spatial distributions of their stellar populations, the relative importance of nuclear continuum sources and subsequent radiative transfer. Estimation of the stellar populations in NGC 891 and the Galaxy indicates that OB stars, and the central stars of planetary nebulae dominate the excitation of their DIMs. Photoionization models require local DIM electron densities of order unity to reproduce the observed emission characteristics of the high-(z) gas. The DIM filling factor in NGC 891 is therefore restricted to the range 10(exp -3.5) approximately less than phi approximately less than 10(exp -1.5), while in the Galaxy phi approximately less than 10(exp -1.2) is suggested. Ionization equilibrium indicates that only approximately 5 percent of the total number of ionizing photons from OB stars escape the neutral disk, highlighting the importance of radiative transfer through the multiphase ISM. The DIM in NGC 1068 demonstrates a bipolar asymmetry common among active galaxies, with high-excitation emission confined to two diametric sectors aligned along the radio jet axis and low-excitation emission uniformly distributed over the disk. We show that this bipolar morphology can be understood using the developing picture of NGC 1068, in which its buried Type 1 Seyfert nucleus is visible only through scattered polarized light. The DIM excitation is therefore anisotropic, with high-excitation gas along the jet axis photoionized by direct nuclear continuum and low-excitation gas away from the axis, illuminated by indirect nuclear emission scattered into it. Photoionization models using power-law continua, indicate that the filling factor of this DIM is restricted to the range 10(exp -5) approximately less than phi approximately less than 10(exp -4) in order to reproduce the observed DIM emission characteristics.

Dissert. Abstr.

N93-24185 Louisiana State Univ., Baton Rouge.
THE STABILITY OF THICK, SELF-GRAVITATING DISKS IN PROTOSTELLAR SYSTEMS Ph.D. Thesis
John William Woodward 1992 233 p
Avail: Univ. Microfilms Order No. DA9301113

We perform a computational survey of the stability of protostellar systems which contain a self-gravitating disk. The systems are initially represented by a point mass M(sub c) at the center and a geometrically thick, axisymmetric disk of mass M(sub d) that supports uniform specific angular momentum and obeys an n = 3/2 polytropic equation of state. The equilibrium disk structure is uniquely defined upon the specification of two key dimensionless system parameters: M(sub d)/M(sub c) and T/W (the ratio of rotational kinetic energy of the disk to the gravitational potential energy of the system). The focus of this work is the identification of systems within the two-dimensional parameter space that are marginally unstable toward the development of nonaxisymmetric distortions. The geometric form of the disk's distortion and the likelihood of disk fragmentation as a result of such instabilities is examined with particular attention given to the formation of binary systems. The principal conclusions of this work are: (a) a computer code which results in data that does not require the application of numerical corrections is essential for the identification of marginally unstable models; (b) models in which the central object is constrained to remain at the center of mass of the system show two principal instabilities, one supplanting the other as the stability of cooler systems is explored; (c) models in which the central object is allowed to move and interact dynamically with the disk indicate that two new instabilities emerge. These new instabilities arise in disks that appear to be stable when the central object is constrained not to move. The instability occurring in the marginally unstable systems promotes the development of a tightly wound, one-armed spiral perturbation in the disk, and (d) disk fragmentation via the one-armed spiral mode is consistent with observations indicating that binary formation is the principal branch of the stellar formation process.

Dissert. Abstr.

N93-24188 Maryland Univ., College Park.
TEMPORAL AND SPATIAL INHOMOGENEITIES IN COMETS Ph.D. Thesis
Nalin Harsha Samarasinha 1992 255 p
Avail: Univ. Microfilms Order No. DA9234648

I have developed a time-dependent model to recover the production rate of a comet's outgassing species (molecules and dust) as a function of time from a series of photometric observations. The model has been applied to Comet Levy (1990c) to derive its dust production rate. Comparison of the dust production rate with spectroscopic data suggests that gaseous species must have a different temporal behavior from that of dust and is indicative of chemical heterogeneity of the nucleus of Comet Levy. I demonstrate using numerical simulations, that it is possible for CN jets seen in Comet P/Halley to evolve into CN shells as suggested by Schulz and Schlosser (1990). In indeed, this is the formation process of CN shells, the ejection velocity of CN in its precursor frame has to be much less than the outflow velocity of the precursors themselves. This rules out the canonical gaseous species as the precursor of CN radicals in CN jets and shells while favoring an origin in grains. In order to construct detailed models of the gaseous jets observed in Comet P/Halley, information about the rotational state of the nucleus is required. I have carried out an extensive search to determine all rotational state of Comet P/Halley which are capable of explaining a wide variety of observational data. I find that the orientation of the large end of the long axis during the Vega-1 encounter must be reversed from that suggested by Sagdeev et al. (1989) in order to satisfy some of the constraints. Neither pure rotations nor Short-Axis Modes are capable of satisfying the constraints. The most likely solutions are Long-Axis Modes. In the most likely modes for the rotational state, the long axis executes a precessional motion around the space-fixed total rotational angular momentum vector with a period near 3.7 days while performing a rotational motion around itself with a period of about 7.3 days. The direction of the total rotational angular momentum implies prograde rotation, but the exact coordinates are not well determined.

Dissert. Abstr.

N93-24453# Iowa State Univ. of Science and Technology, Ames.
VERY HIGH ENERGY GAMMA RAY ASTROPHYSICS
R. C. Lamb and D. A. Lewis 1 Feb. 1993 17 p
(Contract DE-FG02-91ER-40634)
(DE93-007625; DOE/ER-40634/2) Avail: CASI HC A03/MF A01

The Crab-Nebula continues to be the 'standard candle' of TeV gamma-ray astronomy. The Whipple Collaboration's observations of it are now confirmed by two French groups. Application of the 'supercuts' technique, developed on the Crab database, has resulted in the observation of a distant, active galaxy, Markarian 421. Markarian 421 is one of 16 active galactic nuclei (AGN's) observed by the EGRET instrument on the Compton Gamma Ray Observatory. The EGRET observations and the

expected attenuation of TeV photons from very distant AGN's gives added impetus to efforts in upgrading the present steoscopic detection system. The upgrade not only improves the sensitivity of the twin telescopes, but also reduces the energy threshold to 100 GeV, at which energy attenuation effects for distant sources are greatly reduced. During the past year the Ilm reflector was operated as a 37-pixel camera, with its performance matching design expectations. During the coming year, its camera will be upgraded to 109 pixels, the 10m camera electronics made to conform to the Ilm electronics, and both systems interfaced to a single, faster computer. Observations of Markarian 421, simultaneous with EGRET, are scheduled for May, 1993. DOE

N93-24477*# California Inst. of Tech., Pasadena.
INWARD ELECTROSTATIC PRECIPITATION OF INTERPLANETARY PARTICLES
Aaron J. Rulison, Richard C. Flagan, and Thomas J. Ahrens 24 Mar. 1993 31 p
(Grant NAGw-1941)
(NASA-CR-192786; NAS 1.26:192786) Avail: CASI HC A03/MF A01

An inward precipitator collects particles initially dispersed in a gas throughout either a cylindrical or spherical chamber onto a small central planchet. The instrument is effective for particle diameters greater than about 1 micron. One use is the collection of interplanetary dust particles (IDPs) which are stopped in a noble gas (xenon) by drag and ablation after perforating the wall of a thin-walled spacecraft-mounted chamber. First, the particles are positively charged for several seconds by the corona production of positive xenon ions from inward facing needles placed on the chamber wall. Then an electric field causes the particles to migrate toward the center of the instrument and onto the planchet. The collection time (on the order of hours for a 1 m radius spherical chamber) is greatly reduced by the use of optimally located screens which reapportion the electric field. Some of the electric field lines terminate on the wires of the screens so a fraction of the total number of particles in the chamber is lost. The operation of the instrument is demonstrated by experiments which show the migration of carbon soot particles with radius of approximately 1 micron in a 5 cm diameter cylindrical chamber with a single field enhancing screen toward a 3.2 mm central collection rod. Author (revised)

N93-24480*# Eloret Corp., Palo Alto, CA.
IMPACT CONTRIBUTION OF PREBIOTIC REACTANTS TO EARTH Final Technical Report, 1 Apr. 1991 - 28 Feb. 1993
Hans R. Aggarwal 25 Mar. 1993 7 p
(Contract NCC2-722)
(NASA-CR-192785; NAS 1.26:192785) Avail: CASI HC A02/MF A01

A study was performed to explore the effectiveness of comets for chemical evolution. The concentration of amino acids in various terrestrial environments was mathematically explored as there is evidence that amino acids formed as a result of cometary impact. First, the initial concentration of amino acids in surface environment after cometary impact was estimated. The effect of hydrothermal vents, ultra-violet rays, and clays was taken into consideration. Next, the absorption of amino acids by clay particles before degradation by ultra-violet light was analyzed. Finally, the effectiveness of clays, ultra-violet, and hydrothermal vents as sinks for cometary amino acids was compared. A mathematical model was then developed for the production of impact deposits on Earth for the past 2 Ga, and the relative thickness distribution was computed for impact deposits produced in 2 Ga. The reported relative thickness distribution of tillites and diamicites of all ages agrees with the thickness calculated from this impact model. This suggests that many of the ancient tillites and diamicites could be of impact origin. The effectiveness of comets was explored on the chemical evolution of amino acids. The effect of sinks such as clays, submarine vents, and UV light on amino acid concentration was considered. Sites favorable to chemical evolution of amino acids were examined, and it was concluded that chemical evolution could have occurred at or above the surface even during periods of intense bombardment of the Earth more than 3.8 billion years ago. Author (revised)

N93-24488*# San Diego State Univ., CA. Dept. of Electrical and Computer Engineering.
PHOTOABSORPTION AND PHOTODISSOCIATION OF MOLECULES IMPORTANT IN THE INTERSTELLAR MEDIUM Final Report, 1 Feb. 1982 - 14 Jan. 1993
Long C. Lee and Masako Suto 18 Mar. 1993 7 p
(Grant NAGw-319)
(NASA-CR-192829; NAS 1.26:192829) Avail: CASI HC A02/MF A01

The photo absorption, photo dissociation, and fluorescence cross sections of interstellar molecules and radicals were measured in the vacuum ultraviolet region. These quantitative optical data are useful for understanding of the formation and destruction processes of molecules under the intense interstellar W radiation field. Infrared (IR) emissions from W excitation of aromatic molecules were also observed in this research program. The research results are useful for studying the sources of the 'unidentified' interstellar infrared (UIR) emission bands. Author (revised)

N93-23879# Lund Observatory (Sweden).
STATUS AND EARLY RESULTS OF THE HIPPARCOS ASTROMETRY PROJECT
L. Lindegren *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 3-8 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23882# Amsterdam Univ. (Netherlands). Inst. of Astronomy.
ENDPOINTS OF STELLAR EVOLUTION: THE INCIDENCE OF STELLAR MASS BLACK HOLES IN THE GALAXY
Edward P. J. vandenHeuvel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 29-36 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23886# Rome Univ. (Italy). Ist. Astronomico.
ACTIVE GALACTIC NUCLEI: THE VIEW FROM SPACE
G. C. Perola *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 59-65 (For primary document see N93-23878 08-88)
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N93-23887# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
X RAY MORPHOLOGY AND THE MASS OF CLUSTERS OF GALAXIES
Ulrich G. Briel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 67-75 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23910# Bremen Univ. (Germany). Center of Applied Space Technology and Microgravity.
ANALYSIS OF THE RESULTS OF THE FIRST YEAR OF OPERATION OF THE MUNICH DUST COUNTER
H. Iglseder, E. Gruen (Max-Planck-Inst. fuer Kernphysik, Heidelberg, Germany.), R. Muenzenmayer (Technische Univ., Munich, Germany.), H. Svedhem (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), and A. Huedepohl (BMW Rolls-Royce AeroEngines G.m.b.H., Lohholf, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 171-172 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23911# Sao Paulo Univ. (Brazil). Inst. Astronomico e Geofisico.
GX301-2/WRA9777 REVISITED: PROBING THE STELLAR WIND THROUGH X RAY OPTICAL DATA
E. Janot-Pacheco *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular

Emphasis on High-Energy Astrophysics Jul. 1992 p 173-174 (For primary document see N93-23878 08-88)
(Grant CNPQ-301050/88-0(RN))
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N93-23913# Commissariat a l'Energie Atomique, Saclay (France). Service d'Astrophysique.
A2163: AN EXCEPTIONALLY HOT CLUSTER OF GALAXIES
M. Arnaud *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 177-178 (For primary document see N93-23878 08-88)
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N93-23920# Universidad Autonoma de Madrid, Cantoblanco (Spain). Lab. de Astrofisica Espacial y Fisica Fundamental.
MULTIWAVELENGTH ANALYSIS OF STARBURST GALAXIES
J. Miguel Mas-Hesse and Miguel Cervino *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 197-198 (For primary document see N93-23878 08-88)
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N93-23925# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
X RAYING THE INTERSTELLAR DUST
Peter Predehl *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 209-210 (For primary document see N93-23878 08-88)
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N93-23926# Observatoire de Besancon (France).
EVIDENCE FOR TWO TYPES OF SOURCES CREATING HALLEY'S COMA
P. Rousselot, F. Vernotte, J. Clairemidi, and G. Moreels *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 211-212 (For primary document see N93-23878 08-88)
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N93-23928# Academy of Sciences, Potsdam (German D.R.).
NEARBY DWARF GALAXIES: DUST MASSES AND THEIR IMPLICATIONS
K.-H. Schmidt and T. Boller (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 219-220 (For primary document see N93-23878 08-88)
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N93-24394*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
STARDUST: STUDIES IN MICROGRAVITY OF CONDENSATION AND AGGLOMERATION OF COSMIC DUST ANALOGUE
F. Ferguson (Virginia Univ., Charlottesville.), L. U. Lilleleht (Virginia Univ., Charlottesville.), J. Nuth, J. R. Stephens (Matrix Corp., Santa Fe, NM.), E. Bussoletti (Istituto Universitario Navale, Naples, Italy.), L. Carotenuto (Microgravity Advanced Research and Support Center, Naples, Italy.), L. Colangeli (Cassino Univ., Italy.), P. DellAversana (Microgravity Advanced Research and Support Center, Naples, Italy.), F. Mele (Microgravity Advanced Research and Support Center, Naples, Italy.), and V. Mennella (Osservatorio Astronomico, Capodimonte, Naples, Italy.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 325-329 Sponsored in part by Italian Space Agency (For primary document see N93-24336 08-12)
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91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N93-22905# Los Alamos National Lab., NM.
LUNAR SCIENCE MEASUREMENTS AND INSTRUMENTS FOR RESOURCE CHARACTERIZATION
D. Vaniman 1992 5 p Presented at the 4th Annual Symposium on Utilization of Local Planetary Resources, Tucson, AZ, 18-28 Feb. 1993
(Contract W-7405-eng-36)
(DE93-005436; LA-UR-92-4155; CONF-930248-1) Avail: CASI HC A01/MF A01

Resource characterization is a requirement for effective production of any product from planetary materials, whether that product is to be used locally or exported. The characterization required is not necessarily costly or extensive; for example, our current knowledge of lunar regolith is probably sufficient for it to be used immediately for shielding purposes. However, other products from regolith (e.g., oxygen and solar-wind gases) will require more thorough and particularly site-specific resource characterization before actual production commences. If global maps of the Moon are obtained by some combination of gamma ray, reflectance, X-ray fluorescence, and/or imaging methods, the task of targeting resource sites will be considerably improved. Once these sites are selected, however, they must be characterized on the ground. The product of this characterization should be useable maps that will maximize the product output and minimize wasted energy and effort. DOE

N93-22949# Los Alamos National Lab., NM.
LASER-INDUCED BREAKDOWN SPECTROSCOPY FOR REMOTE ELEMENTAL ANALYSIS OF PLANETARY SURFACES
J. D. Blacic, D. R. Pettit, D. A. Cremers, and N. Roessler (McDonnell-Douglas Electronics Co., Saint Louis, MO.) 1992 12 p Presented at the International Symposium on Spectral Sensing Research, Maui, HI, 15-20 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003865; LA-UR-92-3940; CONF-9211130-3) Avail: CASI HC A03/MF A01

One of the most fundamental pieces of information about any planetary body is the elemental and mineralogical composition of its surface materials. We are developing an instrument to obtain such data at ranges of up to several hundreds of meters using the technique of Laser-Induced Breakdown Spectroscopy, or LIBS. The elemental analysis is based on atomic emission spectroscopy of a laser-induced plasma or spark. A pulsed, diode-pumped ND:YAG laser of several hundred mJ optical energy is used to vaporize and electronically excite the constituent elements of a rock surface remotely located from the laser. Light emitted from the excited plasma is collected and introduced to the entrance slit of a small grating spectrometer. The spectrally dispersed spark light is detected with either a linear photodiode array or area CCD array. When the latter detector is used, the optical and spectrometer components of the LIBS instrument can also be used in a passive imaging mode to collect and integrate reflected sunlight from the same rock surface. Absorption spectral analysis of this reflected light gives mineralogical information that, when combined with the elemental analysis from the LIBS mode, provides a complete remote geochemical characterization of the rock surface. We have performed laboratory calibrations in air and in vacuum on standard rock powders to quantify the LIBS analysis. We have performed a preliminary field test using commonly available laboratory components to demonstrate remote LIBS analysis of terrestrial rock surfaces at ranges of over 25 meters. Based on these results, we believe that all major and most minor elements expected on planetary surfaces can be measured with absolute accuracy of 10-15 percent and much higher relative accuracy. DOE

N93-23096*# Southwest Research Inst., San Antonio, TX. Space Sciences Div.

SO2 ON VENUS: A FINAL CROSS-CALIBRATION WITH PIONEER VENUS Final Report

S. Alan Stern 1 Mar. 1993 18 p

(Grant NAG5-1913; SwRI Proj. 15-4914)

(NASA-CR-192273; NAS 1.26:192273) Avail: CASI HC A03/MF A01

In the present reporting period we have met with the Pioneer Venus PI to collaborate on the recalibration of the UV spectrometer of Pioneer Venus. The associated data reduction and analysis activities have been completed. The sensitivity of the UV spectrometer has been steadily declining since orbit insertion of Pioneer Venus in 1978 due to aging of the detector tubes. The sensitivity decline is a strong function of wavelength and the rate of decline is also a function of time. Measures were taken to reduce the light dose received by the instrument to slow down the sensitivity decline. The stellar calibration using the bright UV star Hadar in 1990 indicates that the sensitivity decline may have slowed down more than have been previously estimated. The derived amount of SO2 from Pioneer Venus depends on the accuracy of the absolute sensitivity of the UV spectrometer. The previous cross calibration between IUE and Pioneer Venus led to the use of the same solar flux data for reducing and modelling data from both IUE and Pioneer Venus. The comparison between the 1991 IUE results and the Pioneer Venus stellar calibration carried out in 1990 will allow a more accurate determination of sensitivity decline of the PV UV spectrometer. The result of this comparison will be crucial in determining the trend of SO2 in the Venus atmosphere.

Derived from text

N93-23192*# Lunar and Planetary Inst., Houston, TX. MSATT Study Group.

WORKSHOP ON CHEMICAL WEATHERING ON MARS, PART 2

Roger Burns, ed. and Amos Banin, ed. 1992 15 p Workshop held at Cocoa Beach, FL, 10-12 Sep. 1992

(Contract NASw-4574)

(NASA-CR-192261; NAS 1.26:192261; LPI-TR-92-04-Pt-2) Avail: CASI HC A03/MF A01

The third Mars Surface and Atmosphere Through Time (MSATT) Workshop, which was held 10-12 Sep. 1992, at Cocoa Beach/Cape Kennedy, focused on chemical weathering of the surface of Mars. The 30 papers presented at the workshop described studies of Martian weathering processes based on results from the Viking mission experiments, remote sensing spectroscopic measurements, studies of the shergottite, nakhlite, and chassignite (SNC) meteorites, laboratory measurements of surface analog materials, and modeling of reaction pathways. A summary of the technical sessions is presented and a list of workshop participants is included.

Derived from text

N93-23221 Rice Univ., Houston, TX.

POSSIBLE POWER SOURCES FOR THE JOVIAN POLAR INFRARED HOT SPOTS Ph.D. Thesis

Jie Zhan 1991 93 p

Avail: Univ. Microfilms Order No. DA9234448

Strong 8-micron infrared hot spots in the polar regions of Jupiter exhibit different behaviors: the northern polar hot spot (hereafter, NPHS) tends to remain fixed in System 3 longitude while the southern polar hot spot (SPHS) drifts. Joule heating associated with Pedersen currents that are generated by the spinning magnetized ionosphere (the Faraday disc dynamo) is proposed as a possible power source for the hot spots. A quantitative perturbation model is used to show that the NPHS is confined by a steep longitudinal magnetic-field gradient to a System 3 longitude of approximately 175 degrees, in agreement with observations. The model also shows that a Joule heating power of about 10(exp 14)-10(exp 15) Watts can be dissipated in the hydrocarbon layer, significantly larger than particle-precipitation power and the radiated power of the hot spots. The drift of the SPHS is hypothesized as being caused by gravity waves. The total energy provided by Joule heating and by the dissipation of the waves constitutes the power for the hot spot; propagation of the waves causes the location of the total energy deposition to move, thus causing the drift of the SPHS. Because of the asymmetry in the polar magnetic field configurations between the two hemispheres, these gravity waves are more likely to deposit energy comparable to the Joule heating energy in the south to heat up the hydrocarbon layer where IR emission originates. The ranges of wavelength and frequency are investigated for waves that propagate mainly in north-south direction. These waves can cause the SPHS to drift at the observed speed of approximately 5km/s and dissipate heat that is comparable to Joule heating in the south but less important than the Joule heating in the north. The current-driven joule-heating model, with the presence of wave modulation, can thus account for the primary features of the Jovian polar hot spots: their power output, the fixed location of the NPHS, and the drift motion of the SPHS.

Dissert. Abstr.

N93-23292# Los Alamos National Lab., NM.

GEOCHEMICAL MAPPING OF THE LUNAR SURFACE USING LASER-INDUCED ION MASS SPECTROMETRY FROM LANDERS AND ROVERS

H. O. Funsten, R. C. Elphic, J. D. Blacic, J. E. Borovsky, D. J. McComas, and J. E. Nordholt 1992 12 p Presented at the International Symposium on Spectral Sensing Research, Maui, HI, 15-20 Nov. 1992

(Contract W-7405-eng-36)

(DE93-003849; LA-UR-92-3821; CONF-9211130-1) Avail: CASI HC A03/MF A01

In-situ lunar geochemical assessment is essential when remotely prospecting for lunar resources or characterizing the mineralogy of a lunar site. We discuss a technique for lunar geochemical mapping from landed platforms using Laser-induced Ion Mass Spectrometry (LIMS). In this technique, a focused diode-pumped Nd:YAG laser on an lunar lander or rover vaporizes a thin layer of a soil or rock target located at a range of 1 to 100 m. The vapor is ionized through electron heating by inverse Bremsstrahlung, and the expanding plasma cloud contains information about the target composition. Ions in this plasma are analyzed using specialized time-of-flight ion mass spectrometry, providing detailed composition analysis of the lunar surface. In considering this technique, we discuss the effects on the ion trajectories of ambient electric and magnetic fields and present a high sensitivity, high mass-resolution mass spectrometer that is capable of detecting low atomic mass abundances, trace elements, and isotopic variations.

DOE

N93-23354 Rice Univ., Houston, TX.

MODEL OF VENUS IONOPAUSE FORMATION Ph.D. Thesis

Mark John Matney 1992 149 p

Avail: Univ. Microfilms Order No. DA9234442

A model is presented that simulates the physics of the Venus mantle plasma. A modified magnetohydrodynamic (MHD) fluid picture is assumed where the post-shock solar wind plasma is mass-loaded by photoionizations and other atomic interactions with exospheric neutral atoms. By assuming Newtonian pressure profiles and draped magnetic field geometry in the mantle, the three-dimensional steady-state flow problem is reduced to a one-dimensional calculation along the stagnation (subsolar) flowline. In addition, the validity of the model assumptions and questions about the plasma thermodynamics are addressed. When the resulting model is run using various solar wind conditions, the computed magnetic field features correspond with those measured by the Pioneer Venus spacecraft. The model reproduces the observed region of sharp ion density gradients, known as the ionopause, that separates the mantle plasma from the denser ionospheric plasma below. The straightforward application of the model reproduces the shape and location of the low-altitude ionopause cases well, but for solar wind conditions that correlate with high-altitude ionopauses, the computed ionopauses tend to be lower than those observed. The addition of anomalous heating terms to the model, however, raises the computed ionopause to locations consistent with the medium altitude cases. The inability of the model to adequately describe the high altitude cases may indicate that they are transient events and thus cannot be simulated in steady state. While the source of the anomalous heating is not specified, the presence of hyperthermal ions or plasma-wave interactions are suggested as possible heating mechanisms.

Dissert. Abstr.

N93-23403 Rice Univ., Houston, TX.

NUMERICAL SIMULATION OF THE JOVIAN TORUS-DRIVEN PLASMA TRANSPORT Ph.D. Thesis

Yong-Shiang Yang 1992 288 p

Avail: Univ. Microfilms Order No. DA9234447

The Rice Convection Model has been modified and applied to the study of the Jovian magnetospheric system, which is interchange unstable. The basic interchange instability of the Io plasma torus is opposed by

pressure gradients in the energetic particles outside the torus. Many simulations have been performed for cases where the overall system is interchange unstable under the ideal-MHD assumption E + v x B = 0. For such cases, the torus breaks up predominantly into long fingers unless the initial condition strongly favors some other mode. The ends of the fingers tend to be rounded, and they are connected to the main torus by tails that thin rapidly with time if the torus runs out of plasma. Our calculations place an upper limit of approx. 1R(sub J) on the average distance between fingers. For an initially asymmetric large-scale torus, fingers generally form on a time scale shorter than the one on which the heavy side of the torus falls outwards. However, the fingers form predominantly on the heavy side. Galileo may observe such finger features outside the Io torus, at L approx. equals 7 to 15. Additionally, in this thesis, drift-wave theory has been used to investigate the effect of energetic (KeV or MeV) particles on the Io torus plasma transport. It is shown that the MHD stability criterion, where in the interchange motion would be completely stabilized if the energy density of the hot stabilizing plasma is greater than or dual to 3/4 of that of the cold unstable plasma, no longer holds owing to the gradient/curvature drift of the energetic particles. This differential-drift effect, which is a departure from the ideal-MHD and frozen-in flux, may play a significant role in plasma transport in the Jovian magnetosphere. Dissert. Abstr.

N93-24579 Oregon State Univ., Corvallis.
MODELING OF FORCED PLANETARY WAVES IN THE MARS ATMOSPHERE Ph.D. Thesis
Jeffery Lee Hollingsworth 1992 339 p
Avail: Univ. Microfilms Order No. DA9238049

Mariner 9 and Viking spacecraft observations during the 1970's have provided evidence for planetary-scale wave-like disturbances in the Mars atmosphere. It has been suggested that possible sources of the wave activity are dynamical instabilities (e.g., barotropic and/or baroclinic instabilities). Another candidate source is forced, quasi-stationary planetary waves. In connection with Mars' enormous relief, both mechanical forcing and large-scale thermal contrasts due to spatially varying surface thermal-inertia and albedo patterns should provide a strong source for planetary-wave activity. In this thesis, we attempt to model aspects of the observed wave activity, focusing on forced planetary waves in the wintertime atmosphere of Mars. Our approach is to apply two dynamical models: a linear primitive equations model and a quasi-linear 'wave, mean-flow' model. Both models have spherical geometry and represent deviations from zonal symmetry in terms of Fourier modes. The former model permits a separation of responses to different elements that make up the total forcing mechanism, whereas the latter is used principally to investigate the role forced planetary waves may play in the Mars polar warming phenomenon. Basic states representing relatively 'non-dusty' and 'highly dusty' conditions near winter solstice allow wavenumber-1 and -2 disturbances to propagate meridionally and vertically into the winter jet. Higher wavenumbers are strongly vertically trapped. Stationary waves in the northern and southern extratropics differ strongly in amplitude, phase and horizontal wave pattern. The possibility for near-resonant, long-period modes in Mars' winter atmosphere is also examined. For several wave-amplitude measures and dissipation strengths, dusty low-frequency responses are an order of magnitude larger than non-dusty ones. Wave, mean-flow simulations using wavenumber-1 or -2 forcings indicate north polar warmings can occur for the dusty basic states. The sensitivity (magnitude, location, and time scale) of a simulated warming to the wave forcing and the dissipation strength is investigated.
Dissert. Abstr.

N93-23890# Observatoire de Paris-Meudon (France). Dept. de Recherche Spatiale.
SPACE EXPLORATION OF PLANETARY AND SATELLITE ATMOSPHERES
Therese Encrenaz *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 95-101 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23918# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Planetary and Space Science Div.
CASSINI/HUYGENS: A MISSION TO SATURN AND TITAN
J.-P. Lebreton and D. L. Matson (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In its* Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 189-194 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-24393# Bayreuth Univ. (Germany). Inst. of Physics.
THERMAL CONVECTION IN ROTATING SYSTEMS AND THE BAND STRUCTURE OF THE MAJOR PLANETS
F. H. Busse *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories Jul. 1992 p 317-324 (For primary document see N93-24336 08-12)
(Grant DFG-Bu-589/1)
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92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation.*

N93-22476*# Southwest Research Inst., San Antonio, TX. Instrumentation and Space Research Div.
STUDIES OF EXTRA-SOLAR OORT CLOUDS AND THE KUIPER DISK Semiannual Report No. 2
S. Alan Stern 20 Mar. 1993 24 p
(Grant NAGw-3023; SwRI Proj. 15-4971)
(NASA-CR-192759; NAS 1.26:192759) Avail: CASI HC A03/MF A01

This is the second report for NAGW-3023, Studies of Extra-Solar Oort Clouds and the Kuiper Disk. We are conducting research designed to enhance our understanding of the evolution and detectability of comet clouds and disks. This area holds promise for also improving our understanding of outer solar system formation, the bombardment history of the planets, the transport of volatiles and organics from the outer solar system to the inner planets, and the ultimate fate of comet clouds around the Sun and other stars. According to 'standard' theory, both the Kuiper Disk and Oort Cloud are (at least in part) natural products of the planetary accumulation stage of solar system formation. One expects such assemblages to be a common attribute of other solar systems. Therefore, searches for comet disks and clouds orbiting other stars offer a new method for infering the presence of planetary systems. Our three-year effort consists of two major efforts: (1) observational work to predict and search for the signatures of Oort Clouds and comet disks around other stars; and (2) modelling studies of the formation and evolution of the Kuiper Disk (KD) and similar assemblages that may reside around other stars, including Beta Pic. These efforts are referred to as Task 1 and 2, respectively. Author (revised)

N93-23011*# Teledyne Brown Engineering, Huntsville, AL. Space Programs.
SOLAR MAXIMUM MISSION/ULTRAVIOLET SPECTROMETER AND POLARIMETER STUDIES Final Report
William Henze, Jr. Feb. 1993 45 p
(Contract NAS8-35921)
(NASA-CR-192463; NAS 1.26:192463; SP93-NASA-3405) Avail: CASI HC A03/MF A01

This final report for NASA Contract No. NAS8-35921 describes various studies performed for the Ultraviolet Spectrometer and Polarimeter (UVSP) experiment, one of several instruments on the Solar Maximum Mission (SMM) satellite which was launched on 14 February 1980. The UVSP consisted primarily of a Gregorian telescope and an Ebert-Fastie spectrometer with a polarimeter that could be inserted into the light path. The spacecraft and most of the instruments, including the UVSP, operated successfully until 23 November 1980, when part of the SMM attitude

control system (fine pointing control) failed. The UVSP was then unable to observe the Sun until 18 April 1984, when the SMM was visited by the space shuttle and the attitude control module was replaced by astronauts. The SMM mission ended when the spacecraft reentered the atmosphere of the Earth and was thereby destroyed on 2 December 1989. The topics covered in this report include the following: (1) ultraviolet stellar polarimetry (probably the first such attempted measurement); no polarization as detected and the upper limits, based on the sensitivity as determined by the observed count rate, are rather high; (2) an investigation into the possible position of the UVSP wavelength drive after it became stuck on 26 April 1985; (3) fast timing tests for sit-and-state observations involving one or two detectors; (4) development of computer subroutines to allow the calculation of the component of the SMM spacecraft orbital velocity along the line of sight to the Sun at any desired time during the 1984/1985 period when the UVSP wavelength drive was operating properly; (5) listing of published research papers; (6) description of the UVSP catalog of observations; and (7) description of UVSP calibration report and data users guide. Author

N93-23067*# Southwest Research Inst., San Antonio, TX. Instrumentation and Space Research Div.

AN MHD STUDY OF THE INTERACTION BETWEEN THE SOLAR WIND AND THE INTERSTELLAR MEDIUM Annual Progress Report

R. S. Steinolfson 15 Mar. 1993 4 p

(Grant NAGw-2621)

(NASA-CR-192353; NAS 1.26:192353) Avail: CASI HC A01/MF A01

The overall objective of this research program is to obtain a better understanding of the interaction between the solar wind and the interstellar medium through the use of numerical solutions of the time-dependent magnetohydrodynamic (MHD) equations. The simulated results will be compared with observations where possible and with the results from previous analytic and numerical studies. The primary progress during the first two years has been to develop codes for 2-D models in both spherical and cylindrical coordinates and to apply them to the solar wind-interstellar medium interaction. Computations have been carried out for both a relatively simple gas-dynamic interaction and a flow-aligned interstellar magnetic field. The results have been shown to compare favorably with models that use more approximations and to modify and extend the previous results as would be expected. Work has also been initiated on the development of a 3-D MHD code in spherical coordinates. Author

N93-23216 Rice Univ., Houston, TX.

A MODIFIED FLOW/FIELD MODEL OF THE SOLAR WIND INTERACTION WITH MARS Ph.D. Thesis

Brian K. Stewart 1992 113 p

Avail: Univ. Microfilms Order No. DA9234445

A modified steady state flow/field model is applied to the direct interaction of the solar wind with the Martian ionosphere. The original flow/field model (Cloutier et al., 1987) is a one-dimensional, self-consistent derivation of differentials in vertical velocity, magnetic field, and ion densities from the coupled MHD equations. While successful in reproducing features of the ionosphere of Venus (Cloutier et al., 1987; McGary, 1987) and of Mars (Stewart, 1989), the flow/field model required an independently specified heating term (Q). The requirement of this term implies the presence of an energy source not accounted for in conventional calculations. This source was previously simulated with the inclusion of Q, but an unrecognized momentum or pressure term may also provide the coupling with the solar wind without the need of the free parameter Q. An in-depth analysis of Pioneer Venus data in relation to the total conservation of momentum of the system led to the discovery that the total momentum was in most cases not entirely accounted for, and that this 'missing' term was correlated with solar wind dynamic pressure. By including this missing pressure, a new set of differential equations, which were also extended to include horizontal velocity terms, was derived. Extrapolation of the missing pressure to Mars gave results that faithfully reproduced the ionospheric features associated with previous flow/field models while maintaining agreement with Viking 1 and 2 observations. Finally, we suggest that the source of P(sub missing) could be a population of suprathermal particles within the ionosphere. The missing pressures in the Viking simulations are consistent with measured suprathermal pressures at Mars (Hanson and Mantas, 1988). Dissert. Abstr.

N93-23227# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 578, OCTOBER 1992. PART 1: (PROMPT REPORTS). DATA FOR SEPTEMBER, AUGUST 1992 AND LATE DATA

Helen E. Coffey, ed. Oct. 1992 140 p

(PB93-134013; SGD-578-Pt-1; LC-79-640375) Avail: CASI HC A07/MF A02

Contents: Data for September 1992; Solar-Terrestrial Environment; IUWDS Alert Periods (Advance and Worldwide); Solar Activity Indices; Solar Flares; Solar Radio Emission; and Stanford Mean Solar Magnetic Field. GRA

N93-23236 California Univ., Los Angeles.

THE SOLAR WIND CONTROL OF RECONNECTION AT THE DAYSIDE MAGNETOPAUSE Ph.D. Thesis

Leland Roy Scurry 1992 287 p

Avail: Univ. Microfilms Order No. DA9301549

The solar wind control of reconnection is examined using both correlation analysis of geomagnetic activity and in situ observations at the magnetopause. The correlation of geomagnetic activity, as measured by the am index, reveals a dependence of reconnection on the direction of the interplanetary magnetic field, the solar wind magnetosonic Mach number, and the solar wind dynamic pressure. In situ observations of accelerated flows and the magnetic normal component at the magnetopause using the ISEE 1 and 2 spacecraft are correlated with solar wind and magnetosheath parameters. The magnitude of the magnetic normal component is found to increase as the solar wind magnetic field clock angle becomes southward. The occurrence of accelerated flows increases with increasing southward field as well. Accelerated flows are found to occur with greater probability when the magnetosheath beta is low. Accelerated flows occur most often near the subsolar point. The direction and location of accelerated flows indicate the merging line tilts according to the direction of the interplanetary magnetic field with an average length of approximately 6 R(sub e). Dissert. Abstr.

N93-23243# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 578, OCTOBER 1992. PART 2: (COMPREHENSIVE REPORTS). DATA FOR APRIL 1992 AND MISCELLANEOUS

Helen E. Coffey, ed. Sep. 1992 66 p

(PB93-134021; SGD-578-Pt-2; LC-79-640375) Avail: CASI HC A04/MF A01

Contents: Data for April 1992; Solar Flares; Solar Radio Bursts at Fixed Frequencies; Solar X-ray Radiation from GOES Satellite Graphs; Mass Ejections from the Sun; Interplanetary Solar Particles and Plasma; Active Prominences and Filaments; and Solar Irradiance. GRA

N93-23334# National Oceanic and Atmospheric Administration, Boulder, CO. Center for Solar-Terrestrial Physics.

WORLD DATA CENTER A FOR SOLAR-TERRESTRIAL PHYSICS. CATALOG OF CORONAL HOLES, 1970-1991

A. Sanchez-Ibarra and M. Barraza-Paredes Oct. 1992 75 p Prepared in cooperation with Universidad de Sonora, Hermosillo (Mexico), Centro de Investigacion en Fisica, and Centro de Investigacion en Astronomia Solar

(PB93-138469; UAG-102) Avail: CASI HC A04/MF A01

Coronal Holes were first noted as 'M' regions that produced periodic geomagnetic disturbances. These were first observed in 1970 by instruments on the Orbiting Solar Observatory (OSO) satellites, and also were noted with optical observations during the total solar eclipse of March 7, 1970. The Apollo Telescope Mount (ATM) on the Skylab manned mission observed in short wavelengths the real nature of Coronal Holes as regions of lower density and temperature than the rest of the solar corona. Three observational periods from Skylab produced substantial data on the development of Coronal Holes as well as their relationship with other types of solar activity. After Skylab, although Coronal Holes were later deduced from radio observations, the main data were obtained by observing the He I 10830A line at the Vacuum Solar Telescope at Kitt Peak National Observatory. These data, continuous from 1977 to date, were published in Solar-Geophysical Data (SGD) as Helium synoptic charts by Carrington Rotation or as Coronal Hole contours plotted on H-alpha synoptic charts. The Skylab observations of Coronal Holes were the subject of exhaustive examination. However, the main data source on Coronal Holes currently

are the synoptic maps published in SGD. This catalog was motivated by the lack of global reference guide. This catalog is based only on summary data for each Carrington Rotation; it presents interesting values and enough data to analyze several aspects of the evolution of Coronal Holes. GRA

N93-23454# New Jersey Inst. of Tech., Newark. Dept. of Physics.
OBSERVATION OF IMPULSIVE ACOUSTIC EVENTS AND THE EXCITATION OF SOLAR OSCILLATIONS Annual Report, 1 Nov. 1991 - 31 Oct. 1992
Sergio R. Restaino, Robin T. Stebbins, and Philip R. Goode 4 Dec. 1992 14 p
(Contract F49620-92-J-0094)
(AD-A259788; AFOSR-92-1008TR) Avail: CASI HC A03/MF A01

The five-minute solar oscillation has been exploited in numerous seismic studies in which internal properties of the Sun have been inferred. It is generally regarded that these modes are excited by turbulent convection in the Sun's outermost layers. The oscillatory wakes caused by impulsive events were observed, matching those described by Lamb (1909). These correspond to the events modeled by Goode, et al., which they associate with excitation of the global five-minute oscillations. GRA

N93-23492 Hawaii Univ., Honolulu.
GLOBAL SOLAR INTENSITY OSCILLATIONS NEAR SOLAR MAXIMUM Ph.D. Thesis
Robert Stephen Ronan 1992 116 p
Avail: Univ. Microfilms Order No. DA9300344

We report on the results of extended observations of global solar oscillations as measured in the Ca K spectral line. We measure p-mode frequency splittings averaged over the radial order of the oscillations modes. Our measurement of the antisymmetric component of the splittings is consistent with previous measurements. We present an inversion for the internal rotation rate as a function of latitude and radius in the convection zone and upper radiative zone from the observed antisymmetric splittings. This inversion reveals a slight increase in the rotation rate at all latitudes going inward from the surface to about 0.9 solar radii. Below this depth there is a decrease in the rotation rate with depth. Latitudinal differential rotation persists throughout much of the convection zone but decreases near the base of the convection zone. Our measurement of the symmetric component of the splittings is of the same order as was reported from the previous solar maximum and is an order of magnitude larger than has been measured near solar minimum. We find evidence for an aspherical fractional sound speed perturbation located at a depth of 0.85 plus or minus 0.05 solar radii. This perturbation has a magnitude of delta c/c approx. equals +9 x 10(exp -4) at the equator relative to the poles. If an internal global magnetic field is the dominant source of the observed symmetric component of the splittings instead of latitudinal gradients in the sound speed then global fields of order 10(exp 5) Gauss would be required in the convection zone. We detect high frequency counterparts to the global p-mode oscillations up to frequencies of 10 mHz in the intermediate degree range. The peak frequencies of the high frequency spectrum and the p-mode eigenfrequencies obey the same dispersion relationship (Duvall's Law) which is derived for the p-mode acoustic cavity. The high frequency 'modes' have linewidths which are roughly constant with frequency. Dissert. Abstr.

N93-23644# Columbia Univ., New York, NY. Astrophysics Lab.
CHAOTIC DYNAMICS OF THE SOLAR CYCLE Annual Report, 1 Nov. 1991 - 30 Nov. 1992
Edward A. Spiegel 30 Nov. 1992 7 p
(Contract F49620-92-J-0061)
(AD-A260039; AFOSR-92-0996TR) Avail: CASI HC A02/MF A01

In modeling the solar cycle, we proceed on the assumption that the processes driving the solar cycle are deterministic. In that case, a chaotic model is a good choice for a description of its complexity. In our modeling, we suppose that the solar activity variation is composed of two distinct, coupled processes: one a conventionally chaotic system, and the other a nonlinear oscillator. This idea comes directly from our analysis of the observations. Since the sun's rotation period is one month, we do not use the daily sunspot number, but work with its monthly average. This quantity shows both the cyclic variation on the eleven year time scale and additional strong fluctuations. If we smooth the data to remove periods less than a year to two, we see the solar cycle clearly exposed. When we subtract this smoothed sunspot number from the monthly average, we obtain the fluctuations in the sunspot number. We show a comparison between the monthly averaged number and the fluctuations for a few cycles. There is a clear correlation between the level of solar activity, as measured by the sunspot number, and the amplitude of the fluctuations in this number. We suggest that the fluctuations and the cyclic behavior correspond to two distinct but interacting processes. GRA

N93-23664# Stanford Univ., CA. Center for Space Science and Astrophysics.
ENVIRONMENTAL CONDITIONS RESPONSIBLE FOR SOLAR ACTIVITY Annual Technical Report, 1 Oct. 1991 - 1 Oct. 1992
Peter A. Sturrock 30 Nov. 1992 18 p
(Contract F49620-92-J-0015)
(AD-A259703; AFSOR-TR-92-1005) Avail: CASI HC A03/MF A01

This report describes progress toward understanding the theoretical basis for solar activity. One of our key accomplishments has been the insight we have gained into the eruption of coronal magnetic structures. Roumeliotis, Sturrock, and Antiochos have made numerical and analytic calculations which indicate that coronal magnetic fields being sheared by convective motions acting on their photospheric footpoints evolve smoothly until the shear surpasses a certain critical amount. After that, the coronal field exhibits very sensitive dependence on the photospheric boundary conditions, in the sense that small changes in the footpoint displacements produce huge changes in the height of the coronal field. We propose that this nonlinear behavior of sheared magnetic fields is the explanation for eruptive phenomena such as coronal mass ejections and solar flares. We are also developing several approaches for understanding coronal heating. In particular, Sturrock has proposed a model in which turbulent reconnection deep within the chromosphere produces local heating as well as a burst of magnetohydrodynamic waves that propagate upward to heat the corona. Roumeliotis is working on the theory that twisted flux loops in the corona undergo an internal resistive kink instability that unwinds the internal field and releases magnetic energy to heat the loop. GRA

N93-23973# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
SOLAR FLARES AND MAGNETOSPHERIC PARTICLES: INVESTIGATIONS BASED UPON THE ONR-602 AND ONR-604 EXPERIMENTS Technical Report
John P. Wefel and T. G. Guzik 15 Oct. 1992 131 p
(Contract N00014-90-J-1466)
(AD-A259781) Avail: CASI HC A07/MF A02

The study of solar flares and the interaction of solar flare radiations with the geospace environment is one of the most fundamental investigations in space science. Involved are basic questions about the mechanism for energy generation in the flare region, the conversion of this energy into high energy charged particles, neutrons, x-rays and gamma rays, the interplanetary propagation of the particles to Earth, the access of these particles to the magnetosphere, and the changes initiated in our local environment due to the solar flare. In the latter case, the solar particles are superposed upon an existing background of geomagnetically trapped and pseudo-trapped charged particles, which are themselves of fundamental importance in the dynamics of the geospace environment. While these questions are quite compelling scientifically, they also have important practical applications. The influence of solar activity and the consequent geomagnetic disturbances on the availability and quality of long range, short wave radio communication is perhaps the best known of the solar effects. With the advent of the space program and the ever increasing use of the space environment for both civilian and military applications, the consequences of space radiations are becoming a major operational concern since possible effects of such radiations include: the long-term degradation of hardware in the space environment, the abrupt failure of space systems due to a short-term event or even a single, intensely ionizing particle, and limitations imposed by the radiation environment on the human presence in orbit. The ability to assess the resulting operational limitations depends both on detailed knowledge of the geospace environment and its spatial and temporal variability and on the degree of sophistication of the space systems that are required to operate there. GRA

N93-24150# National Geophysical Data Center, Boulder, CO. Solar-Terrestrial Physics Div.

SOLAR-GEOPHYSICAL DATA NUMBER 579, NOVEMBER 1992. PART 2: (COMPREHENSIVE REPORTS). DATA FOR MAY 1992 AND MISCELLANEOUS

Helen E. Coffey, ed. May 1992 56 p

(PB93-141711; SGD-579-Pt-2; LC-79-640375) Avail: CASI HC A04/MF A01

Contents: Detailed index for 1992; Data for May 1992--Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments, Solar irradiance; International Geophysical Calendar 1993-Explanations and recommended scientific programs. GRA

N93-24175# National Geophysical Data Center, Boulder, CO. Solar Terrestrial Physics Div.

SOLAR-GEOPHYSICAL DATA NUMBER 579, NOVEMBER 1992. PART 1: (PROMPT REPORTS). DATA FOR OCTOBER, SEPTEMBER 1992, AND LATE DATA

Helen E. Coffey, ed. Nov. 1992 131 p

(PB93-141703; SGD-579-Pt-1; LC-79-640375) Avail: CASI HC A07/MF A02

Contents: Detailed index for 1992; Data for October 1992--Solar-terrestrial environment, IUWDS alert periods (advance and worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field; Data for September 1992--Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, Geomagnetic indices; Late Data--Cosmic ray measurements by neutron monitor--Thule August 1992, International Geophysical Calendar 1993--Explanations and recommended scientific programs. GRA

N93-24268# California Univ., San Diego, La Jolla.

REMOTE SENSING OF INNER HELIOSPHERIC PLASMAS Annual Report, 15 Nov. 1991 - 14 Nov. 1992

Bernard V. Jackson 15 Dec. 1992 24 p

(Grant AF-AFOSR-0091-91)

(AD-A260337; AFOSR-TR-93-0026) Avail: CASI HC A03/MF A01

Solar disturbances produce major effects on the corona, the solar wind, the interplanetary medium, and the Earth along with its magnetosphere. New techniques for studying plasma disturbances in the inner heliosphere by remotely sensing them were developed. These techniques use data from the HELIOS spacecraft zodiacal light photometers, the ISEE-3 spacecraft kilometer radio-wave experiment, and a variety of other spacecraft and ground-based instruments. Use of interplanetary scintillation (IPS) data from the Cambridge, England radio telescope was added. The zodiacal-light photometers on board the two HELIOS spacecraft (data coverage from 1974 to 1986) provide the first good information about the heliospheric masses and shapes of propagating disturbances. Metric and kilometric type 2 and type 3 radiation caused by shock waves and fast moving electrons respectively are another way to remotely sense the structures which propagate outward from the Sun. The best kilometric radio-wave sensing of inner heliospheric plasma is available from the ISEE-3 spacecraft, and recently these data were used to obtain crude images of the Earth's magnetosphere. The investigations into the physics of the disturbances sensed by these techniques and the ability to forecast them are underway. GRA

N93-24284# Kansas Univ., Lawrence. Dept. of Physics and Astronomy.

A NITRATE SIGNAL OF SOLAR FLARES IN POLAR SNOW AND ICE Annual Report, 1 Nov. 1991 - 31 Oct. 1992

Gisela A. Dreschhoff and Edward J. Zeller 1 Nov. 1992 25 p

(Grant AF-AFOSR-0065-88)

(AD-A260559; AFOSR-92-0999TR) Avail: CASI HC A03/MF A01

The operations described in this report are separated into two sections, one involving the high-resolution sampling, analysis, and interpretation of a firn core from Windless Bight Antarctica and a second section concerned with the acquisition of a 120 meter firn core from the GISP2 site in Central Greenland. Most of the Antarctic work is involved with detailed correlation with records from two-drill cores located - 10 km apart on the Ross Ice Shelf where snow deposition involves little mixing and highly precise correlations are possible with known solar flare events. In Greenland, a much longer time period of roughly 400 years has been sampled. The core drilling was completed in June 1992 and the cores have been shipped to the National Ice Core Storage Facility in Denver, Colorado. The upper - 12 meters of firn core was analyzed on site in Greenland and shows that a high quality ice core record can be obtained. GRA

N93-24335# National Geophysical and Solar-Terrestrial Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 580, DECEMBER 1992. PART 1: (PROMPT REPORTS). DATA FOR NOVEMBER, OCTOBER 1992, AND LATE DATA

Helen E. Coffey, ed. Dec. 1992 132 p

(PB93-150332; SGD-580-Pt-1) Avail: CASI HC A07/MF A02

Contents: Detailed index for 1992; Data for November 1992--Solar-terrestrial environment, IUWDS alert periods (Advance and Worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field; Data for October 1992--Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, Geomagnetic indices; Late data--Cosmic rays Climax Jul.-Sep. 92, Huancayo Jun.-Aug. 92, Geomagnetic dst index Jul 92. GRA

N93-24558# National Geophysical and Solar-Terrestrial Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 580, DECEMBER 1992. PART 2: (COMPREHENSIVE REPORTS). DATA FOR JUNE 1992, AND MISCELLANEOUS

Helen E. Coffey Dec. 1992 65 p

(PB93-150340; SGD-580-Pt-2) Avail: CASI HC A04/MF A01

Contents: Detailed index for 1992 Data for June 1992--Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments, Solar irradiance, IMP-8 solar wind plot; Miscellaneous data--IMP-8 solar wind plots Mar.-May. 1992. GRA

N93-24633# European Space Agency, Paris (France).

ANISOTROPIC REFLECTIONS IN MOUNTAINOUS TERRAIN TO DETERMINE THE ABSORPTION OF SOLAR RADIATION FROM SATELLITE DATA

Gerhard H. Ruppersberg (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) and Ruediger H. Bull Aug. 1992 56 p Transl. into ENGLISH of Anisotrope Reflexion im Gebirge: Ihre Bedeutung fuer die Bestimmung der Absorption solarer Strahlung aus Satellitendaten Original language document was announced as N92-14959

(ESA-TT-1262; DLR-FB-91-06; ETN-93-93517) Avail: CASI HC A04/MF A01; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The anisotropic factors of quasi-three-dimensionally modeled areas in the Alps (Europe) with an extent of approximately 60 sq km are calculated for two wavelengths in the solar spectral region. For light snow cover, even simple assumptions concerning the reflection function of the elements of area return very accurate values of absorptance and radiation balance. With increasing snow cover, however, large errors can occur if reflection anisotropy of the snow fields is not adequately considered. With Meteosat measurements, anisotropic factors, f, are required which also take into account this effect, using NOAA AVHRR (Advanced Very High Resolution Radiometer) measured values and assuming that $f = 1$ already yields very accurate absorptances by imposing a restriction to the midday overpasses and positions of the areas around a nadir of +/- 273 km. ESA

N93-24637 Institut d'Aeronomie Spatiale de Belgique, Brussels.

MULTIPLE MOLECULAR SCATTERING AND ALBEDO ACTION ON THE SOLAR SPECTRAL IRRADIANCE IN THE REGION OF THE UVB (LESS THAN OR EQUAL TO 320 NM): A PRELIMINARY INVENTORY

Marcel Nicolet 1991 70 p Submitted for publication Sponsored by Commission of European Communities

(Aeronomica-Acta-A-363-1991; ETN-93-93537) Avail: Inst. d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

A study comparing, in the spectral UVB region, the various components of the solar radiation field in order to explain the large difference obtained in Apr. 1939 by Goetz in Chur (green meadows), Nicolet in Arosa (adequate

location in the snow) and Penndorf on the Weisshorn (above the ski slopes) (Switzerland) is presented. Numerical results from detailed theoretical calculations aimed at evaluating the various absolute effects associated with height, solar zenith angle and surface albedo were obtained for the standard atmosphere. The variations with solar zenith angles from 0 to 90 deg and albedos between 0 and 1 are presented for a spherical terrestrial atmosphere at selected wavelengths between 301 and 325 nm in the UVB region. From simultaneous measurements made at the same solar zenith angles, it was found that the values obtained in Arosa were between 5 and 10 times those obtained in Chur and on the Weisshorn. Such results are explained by a maximum of reflectivity of the snow covering the slope facing the relatively low Sun and its associated multiple scattered radiation in addition to the multiple molecular scattering of the atmosphere. ESA

N93-23921# Athens Univ. (Greece). Space Physics Group.
ENERGETIC PARTICLE ACCELERATION AND PROPAGATION IN THE HELIOSPHERE
X. Moussas, Z. Theodossiou-Ekaterinidi (Siemens A.E., Athens, Greece.), J. J. Quenby (Imperial Coll. of Science and Technology, London, England.), P. L. Newman (Imperial Coll. of Science and Technology, London, England.), J. F. Valdes-Galicia (Universidad Autonoma de Madrid, Cantoblanco, Spain.), A. G. Drillia, D. Roulias, and A. Alevizos *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 199-200 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23931*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SUMER: SOLAR ULTRAVIOLET MEASUREMENTS OF EMITTED RADIATION
K. Wilhelm (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany.), W. I. Axford (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany.), W. Curdt (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany.), A. H. Gabriel (Institut d'Astrophysique, Paris, France.), M. Grewing (Tuebingen Univ., Germany.), M. C. E. Huber (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.), S. D. Jordan, M. Kuehne (Physikalisch-Technische Bundesanstalt, Berlin, Germany.), P. Lemaire (Institut d'Astrophysique, Paris, France.), and E. Marsch (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 225-226 Sponsored by BMFT/DARA; CNES; and PRODEX (For primary document see N93-23878 08-88)
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93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N93-22544# Los Alamos National Lab., NM.
NEW APPROACH TO THE INTERACTION OF COSMIC RAYS WITH NUCLEI IN SPACECRAFT SHIELDING AND THE HUMAN BODY
B. W. Bush and J. R. Nix Jan. 1993 50 p
(Contract W-7405-eng-36)
(DE93-006263; LA-12452-MS) Avail: CASI HC A03/MF A01

The interaction of high-energy cosmic rays with nuclei in spacecraft shielding and the human body is important for manned interplanetary missions and is not well understood either experimentally or theoretically. We present a new theoretical approach to this problem based on classical hadrodynamics for extended nucleons, which treats nucleons of finite size interacting with massive meson fields. This theory represents the classical analogue of the quantum hadrodynamics of Serot and Walecka without the assumptions of the mean-field approximation and point nucleons. It provides a natural covariant microscopic approach to collisions between cosmic rays and nuclei that automatically includes space-time non-locality and retardation, nonequilibrium phenomena, interactions among all nucleons, and particle production. Unlike previous models, this approach is manifestly Lorentz covariant and satisfies a priori the basic conditions that are present when cosmic rays collide with nuclei, namely an interaction time that is extremely short and a nucleon mean-free path, force range, and internucleon separation that are all comparable in size. We review the history of classical meson-field theory and derive the classical relativistic equations of motion for nucleons of finite size interacting with massive scalar and vector meson fields. DOE

N93-22707# Los Alamos National Lab., NM.
COSMIC-RAY-VETO DETECTOR SYSTEM
D. W. Miller and H. O. Menlove Dec. 1992 9 p
(Contract W-7405-eng-36)
(DE93-004787; LA-12469-MS) Avail: CASI HC A02/MF A01

To reduce the cosmic-ray-induced neutron background, we are testing a cosmic-ray veto option with a neutron detector system that uses plastic scintillator slabs mounted on the outside of a H-3-tube detector. The scintillator slabs eliminate unwanted cosmic-ray events, enabling the detector to assay low-level plutonium samples, for which a low-background coincident signature is critical. This report describes the design and testing of the prototype cosmic-ray-veto detector system. DOE

N93-22749# Los Alamos National Lab., NM.
GAMMA RAY PULSARS AND GEMINGA
M. Ruderman, J. P. Halpern (Columbia Univ., New York, NY.), K. Chen, and K. S. Cheng (Hong Kong Univ.) 1992 15 p Presented at the Gamma Ray Observatory Symposium, St. Louis, MO, 14-18 Oct. 1992
(Contract W-7405-eng-36)
(DE93-005452; LA-UR-92-4006; CONF-9210245-2) Avail: CASI HC A03/MF A01

Observed properties of gamma-ray pulsars are related to those of the accelerators which power their radiation. It is argued that the relatively slowly spinning Geminga is a strong gamma-ray source only because its magnetic dipole is more inclined than that of the more rapidly spinning Vela. This would also account for special Geminga properties including 180 degrees subpulse separation, soft x-ray spectra and intensities, and suppression of radio emission. DOE

N93-23396*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
POLARIZATION CORRECTION FOR IONIZATION LOSS IN A GALACTIC COSMIC RAY TRANSPORT CODE (HZETRN)
Judy L. Shinn, Hamidullah Farhat (Old Dominion Univ., Norfolk, VA.), Francis F. Badavi (Christopher Newport Coll., Newport News, VA.), and John W. Wilson Washington Mar. 1993 11 p
(RTOP 593-41-21-01)
(NASA-TM-4443; L-17192; NAS 1.15:4443) Avail: CASI HC A03/MF A01

An approximate polarization correction for ionization loss suggested by Sternheimer has been implemented in the galactic cosmic ray transport code (HZETRN) developed at the Langley Research Center. Sample calculations made for the aluminum shield and liquid hydrogen shield show no more than a plus or minus 2 percent change in the linear energy transfer (LET) distribution for flux compared with those without polarization correction. This very small change is expected because the effect of polarization correction on the reduction in stopping power of ions with energies above 2 GeV/amu is suppressed by the decrease in galactic cosmic ray ion flux at such high energies. Author (revised)

N93-23687# Los Alamos National Lab., NM.
GAMMA RAY BURST RESULTS FROM DMSP SATELLITES
J. Terrell, P. Lee, R. W. Klebesadel, and J. W. Griffee (Sandia National Labs., Albuquerque, NM.) 1992 6 p Presented at the Gamma Ray Observatory (GRO) Symposium, St. Louis, MO, 14-18 Oct. 1992
(Contract W-7405-eng-36)
(DE93-003823; LA-UR-92-3734; CONF-9210245-1) Avail: CASI HC A02/MF A01

Gamma-ray burst detectors are aboard three U.S. Air Force Defense Meteorological Satellite Program (DMSP) spacecraft, in orbit at 800 km altitude. A large number of bursts have been detected by DMSP, often

confirming and supplementing data from GRO and other spacecraft, sometimes detecting bursts not otherwise known. The position of an unknown source may be considerably restricted by knowledge of the several DMSP spacecraft locations and fields of view. These data may be of considerable assistance in understanding the gamma-ray burst phenomenon. DOE

N93-23893*# Hoyle (Fred), Bournemouth (England).
GAMMA RAY BURSTS FROM EXTRAGALACTIC SOURCES
Fred Hoyle and Geoffrey Burbidge (California Univ., La Jolla.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 119-123 (For primary document see N93-23878 08-88)
(Grant NAGw-1737)
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N93-23899# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
EXTRAGALACTIC RADIO SOURCES IN THE ROSAT SURVEY
W. Brinkmann, T. Boller, and J. Siebert *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 143-144 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23900# Landessternwarte auf dem Koenigstuhl, Heidelberg (Germany).
EMISSION FROM RELATIVISTIC JETS IN BLAZARS
M. Camenzind *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 145-146 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23901# Consejo Superior de Investigaciones Cientificas, La Laguna (Spain). Inst. de Astrofisica de Canarias.
THE X RAY TRANSIENT GS2023+338: THE 0(SUP d).24 AND 6(SUP d).5 MODULATIONS
J. Casares, P. A. Charles (Royal Greenwich Observatory, Tenerife, Spain.), and E. P. Pavlenko (Crimean Astrophysical Observatory, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 147-148 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23906*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPECTRAL EVOLUTION DURING A COMPLEX GAMMA RAY BURST OBSERVED WITH BATSE
D. E. Gruber (California Univ., San Diego.), D. L. Band (California Univ., San Diego.), L. Ford (California Univ., San Diego.), J. L. Matteson (California Univ., San Diego.), C. L. Meegan, R. B. Wilson, G. J. Fishman, W. S. Paciesas (Alabama Univ., Huntsville.), G. N. Pendleton (Alabama Univ., Huntsville.), and B. Schaefer (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 161-162 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23907# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
SOFT X RAY EMISSION FROM SUPERGIANT X RAY BINARIES DETECTED ON THE ROSAT ALL-SKY SURVEY
Frank Haberl, Tomaso Belloni, and Fotis Mavromatakis *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 163-164 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-23929# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
SEARCH FOR GAMMA RAY BURST SOURCES BY COORDINATED OBSERVATIONS FROM ULYSSES, GRO, AND PVO
M. Sommer and K. Hurley (California Univ., Berkeley.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics Jul. 1992 p 221-222 (For primary document see N93-23878 08-88)
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

99 GENERAL

N93-22149*# National Aeronautics and Space Administration, Washington, DC.
TECHNOLOGY 2002: THE THIRD NATIONAL TECHNOLOGY TRANSFER CONFERENCE AND EXPOSITION, VOLUME 2
Michael Hackett, comp. Feb. 1993 500 p Conference and Exposition held in Baltimore, MD, 1-3 Dec. 1992
(NASA-CP-3189-Vol-2; NAS 1.55:3189-Vol-2) Avail: CASI HC A21/MF A04

Proceedings from symposia of the Technology 2002 Conference and Exposition, December 1-3, 1992, Baltimore, MD. Volume 2 features 60 papers presented during 30 concurrent sessions. For individual titles, see N93-22150 through N93-22203.

N93-22150*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TRANSPORTABLE APPLICATIONS ENVIRONMENT (TAE) PLUS: A NASA TOOL FOR BUILDING AND MANAGING GRAPHICAL USER INTERFACES **c61**
Martha R. Szczur *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 3-12 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

The Transportable Applications Environment (TAE) Plus, developed at NASA's Goddard Space Flight Center, is an advanced portable user interface development which simplifies the process of creating and managing complex application graphical user interfaces (GUI's). TAE Plus supports the rapid prototyping of GUI's and allows applications to be ported easily between different platforms. This paper will discuss the capabilities of the TAE Plus tool, and how it makes the job of designing and developing GUI's easier for application developers. TAE Plus is being applied to many types of applications, and this paper discusses how it has been used both within and outside NASA. Author

N93-22151*# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.
ADVANCED DISPLAY OBJECT SELECTION METHODS FOR ENHANCING USER-COMPUTER PRODUCTIVITY **c61**
Glenn A. Osga *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 13-17 Sponsored in part by Office of Naval Technology (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

The User-Interface Technology Branch at NCCOSC RDT&E Division has been conducting a series of studies to address the suitability of commercial off-the-shelf (COTS) graphic user-interface (GUI) methods for efficiency and performance in critical naval combat systems. This paper presents an advanced selection algorithm and method developed to increase user performance when making selections on tactical displays. The method has also been applied with considerable success to a variety of cursor and pointing tasks. Typical GUI's allow user selection by: (1) moving a

cursor with a pointing device such as a mouse, trackball, joystick, touchscreen; and (2) placing the cursor on the object. Examples of GUI objects are the buttons, icons, folders, scroll bars, etc. used in many personal computer and workstation applications. This paper presents an improved method of selection and the theoretical basis for the significant performance gains achieved with various input devices tested. The method is applicable to all GUI styles and display sizes, and is particularly useful for selections on small screens such as notebook computers. Considering the amount of work-hours spent pointing and clicking across all styles of available graphic user-interfaces, the cost/benefit in applying this method to graphic user-interfaces is substantial, with the potential for increasing productivity across thousands of users and applications. Author

N93-22152*# Advanced Communications Technology, Inc., Silver Spring, MD.

UNIVERSAL INDEX SYSTEM **c82**

Steve Kelley, Nick Roussopoulos, Timos Sellis, and Sarah Wallace *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 18-28 (For primary document see N93-22149 08-99)

Avail: CASI HC A03/MF A04

The Universal Index System (UIS) is an index management system that uses a uniform interface to solve the heterogeneity problem among database management systems. UIS provides an easy-to-use common interface to access all underlying data, but also allows different underlying database management systems, storage representations, and access methods. Author

N93-22153*# Netrologic, Inc., San Diego, CA.

THE DEVELOPMENT OF A NATURAL LANGUAGE INTERFACE TO A GEOGRAPHICAL INFORMATION SYSTEM **c82**

Sue Walker Toledo and Bruce Davis *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 29-42 Prepared for NASA, John C. Stennis Space Center, Bay Saint Louis, MS (For primary document see N93-22149 08-99)

Avail: CASI HC A03/MF A04

This paper will discuss a two and a half year long project undertaken to develop an English-language interface for the geographical information system GRASS. The work was carried out for NASA by a small business, Netrologic, based in San Diego, California, under Phase 1 and 2 Small Business Innovative Research contracts. We consider here the potential value of this system whose current functionality addresses numerical, categorical and boolean raster layers and includes the display of point sets defined by constraints on one or more layers, answers yes/no and numerical questions, and creates statistical reports. It also handles complex queries and lexical ambiguities, and allows temporarily switching to UNIX or GRASS. Author

N93-22154*# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.

AN APPLICATION PROTOCOL FOR CAD TO CAD TRANSFER OF ELECTRONIC INFORMATION **c82**

Charles C. Azu, Jr. *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 45-54 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

The exchange of Computer Aided Design (CAD) information between dissimilar CAD systems is a problem. This is especially true for transferring electronics CAD information such as multi-chip module (MCM), hybrid microcircuit assembly (HMA), and printed circuit board (PCB) designs. Currently, there exists several neutral data formats for transferring electronics CAD information. These include IGES, EDIF, and DXF formats. All these formats have limitations for use in exchanging electronic data. In an attempt to overcome these limitations, the Navy's MicroCIM program implemented a project to transfer hybrid microcircuit design information between dissimilar CAD systems. The IGES (Initial Graphics Exchange Specification) format is used since it is well established within the CAD industry. The goal of the project is to have a complete transfer of microelectronic CAD information, using IGES, without any data loss. An Application Protocol (AP) is being developed to specify how hybrid microcircuit CAD information will be represented by IGES entity constructs. The AP defines which IGES data items are appropriate for describing HMA geometry, connectivity, and processing as well as HMA material characteristics. Author

N93-22155*# Analex Space Systems, Inc., Cocoa Beach, FL.

METHODS AND MEANS USED IN PROGRAMMING INTELLIGENT SEARCHES OF TECHNICAL DOCUMENTS **c82**

David L. Gross *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 55-62 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

In order to meet the data research requirements of the Safety, Reliability & Quality Assurance activities at Kennedy Space Center (KSC), a new computer search method for technical data documents was developed. By their very nature, technical documents are partially encrypted because of the author's use of acronyms, abbreviations, and shortcut notations. This problem of computerized searching is compounded at KSC by the volume of documentation that is produced during normal Space Shuttle operations. The Centralized Document Database (CDD) is designed to solve this problem. It provides a common interface to an unlimited number of files of various sizes, with the capability to perform any diversified types and levels of data searches. The heart of the CDD is the nature and capability of its search algorithms. The most complex form of search that the program uses is with the use of a domain-specific database of acronyms, abbreviations, synonyms, and word frequency tables. This database, along with basic sentence parsing, is used to convert a request for information into a relational network. This network is used as a filter on the original document file to determine the most likely locations for the data requested. This type of search will locate information that traditional techniques, (i.e., Boolean structured key-word searching), would not find. Author

N93-22156*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AN INTEGRATED INFORMATION RETRIEVAL AND DOCUMENT MANAGEMENT SYSTEM **c82**

L. Stephen Coles, J. Fernando Alvarez, James Chen, William Chen, Lai-Mei Cheung, Susan Clancy, and Alexis Wong *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 63-72 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

This paper describes the requirements and prototype development for an intelligent document management and information retrieval system that will be capable of handling millions of pages of text or other data. Technologies for scanning, Optical Character Recognition (OCR), magneto-optical storage, and multiplatform retrieval using a Standard Query Language (SQL) will be discussed. The semantic ambiguity inherent in the English language is somewhat compensated-for through the use of coefficients or weighting factors for partial synonyms. Such coefficients are used both for defining structured query trees for routine queries and for establishing long-term interest profiles that can be used on a regular basis to alert individual users to the presence of relevant documents that may have just arrived from an external source, such as a news wire service. Although this attempt at evidential reasoning is limited in comparison with the latest developments in AI Expert Systems technology, it has the advantage of being commercially available. Author

N93-22157*# Lockheed Engineering and Sciences Co., Bay Saint Louis, MS. Advanced Sensor Development Lab.

AN INVESTIGATIVE STUDY OF MULTISPECTRAL DATA COMPRESSION FOR REMOTELY-SENSED IMAGES USING VECTOR QUANTIZATION AND DIFFERENCE-MAPPED SHIFT-CODING **c61**

S. Jaggi *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 73-88 (For primary document see N93-22149 08-99)

(Contract NAS13-315)

Avail: CASI HC A03/MF A04

A study is conducted to investigate the effects and advantages of data compression techniques on multispectral imagery data acquired by NASA's airborne scanners at the Stennis Space Center. The first technique used was vector quantization. The vector is defined in the multispectral imagery context as an array of pixels from the same location from each channel. The error obtained in substituting the reconstructed images for

the original set is compared for different compression ratios. Also, the eigenvalues of the covariance matrix obtained from the reconstructed data set are compared with the eigenvalues of the original set. The effects of varying the size of the vector codebook on the quality of the compression and on subsequent classification are also presented. The output data from the Vector Quantization algorithm was further compressed by a lossless technique called Difference-mapped Shift-extended Huffman coding. The overall compression for 7 channels of data acquired by the Calibrated Airborne Multispectral Scanner (CAMS), with an RMS error of 15.8 pixels was 195:1 (0.41 bpp) and with an RMS error of 3.6 pixels was 18:1 (.447 bpp). The algorithms were implemented in software and interfaced with the help of dedicated image processing boards to an 80386 PC compatible computer. Modules were developed for the task of image compression and image analysis. Also, supporting software to perform image processing for visual display and interpretation of the compressed/classified images was developed. Author

N93-22158*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A MACRO-MICRO ROBOT FOR PRECISE FORCE APPLICATIONS c63
Neville I. Marzwell and Yulun Wang (Computer Motion, Inc., Goleta, CA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 91-100 Sponsored in part by NSF (For primary document see N93-22149 08-99)
(Contract NAS7-1149)
Avail: CASI HC A02/MF A04

This paper describes an 8 degree-of-freedom macro-micro robot capable of performing tasks which require accurate force control. Applications such as polishing, finishing, grinding, deburring, and cleaning are a few examples of tasks which need this capability. Currently these tasks are either performed manually or with dedicated machinery because of the lack of a flexible and cost effective tool, such as a programmable force-controlled robot. The basic design and control of the macro-micro robot is described in this paper. A modular high-performance multiprocessor control system was designed to provide sufficient compute power for executing advanced control methods. An 8 degree of freedom macro-micro mechanism was constructed to enable accurate tip forces. Control algorithms based on the impedance control method were derived, coded, and load balanced for maximum execution speed on the multiprocessor system. Author

N93-22159*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A FAULT-TOLERANT INTELLIGENT ROBOTIC CONTROL SYSTEM c63
Neville I. Marzwell and Kam Sing Tso (SoHaR, Inc., Beverly Hills, CA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 101-110 (For primary document see N93-22149 08-99)
(Contract NAS7-1172)
Avail: CASI HC A02/MF A04

This paper describes the concept, design, and features of a fault-tolerant intelligent robotic control system being developed for space and commercial applications that require high dependability. The comprehensive strategy integrates system level hardware/software fault tolerance with task level handling of uncertainties and unexpected events for robotic control. The underlying architecture for system level fault tolerance is the distributed recovery block which protects against application software, system software, hardware, and network failures. Task level fault tolerance provisions are implemented in a knowledge-based system which utilizes advanced automation techniques such as rule-based and model-based reasoning to monitor, diagnose, and recover from unexpected events. The two level design provides tolerance of two or more faults occurring serially at any level of command, control, sensing, or actuation. The potential benefits of such a fault tolerant robotic control system include: (1) a minimized potential for damage to humans, the work site, and the robot itself; (2) continuous operation with a minimum of uncommanded motion in the presence of failures; and (3) more reliable autonomous operation providing increased efficiency in the execution of robotic tasks and decreased demand on human operators for controlling and monitoring the robotic servicing routines. Author

N93-22160*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MULTI-BEAM RANGE IMAGER FOR AUTONOMOUS OPERATIONS c36
Neville I. Marzwell, H. Sang Lee (Science and Engineering Services, Inc., Burtonsville, MD.), and R. Ramaswami (Science and Engineering Services, Inc., Burtonsville, MD.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 111-118 (For primary document see N93-22149 08-99)
(Contract NAS7-1186)
Avail: CASI HC A02/MF A04

For space operations from the Space Station Freedom the real time range imager will be very valuable in terms of refuelling, docking as well as space exploration operations. For these applications as well as many other robotics and remote ranging applications, a small potable, power efficient, robust range imager capable of a few tens of km ranging with 10 cm accuracy is needed. The system developed is based on a well known pseudo-random modulation technique applied to a laser transmitter combined with a novel range resolution enhancement technique. In this technique, the transmitter is modulated by a relatively low frequency of an order of a few MHz to enhance the signal to noise ratio and to ease the stringent systems engineering requirements while accomplishing a very high resolution. The desired resolution cannot easily be attained by other conventional approaches. The engineering model of the system is being designed to obtain better than 10 cm range accuracy simply by implementing a high precision clock circuit. In this paper we present the principle of the pseudo-random noise (PN) lidar system and the results of the proof of experiment. Author

N93-22161*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ROBOSIM: AN INTELLIGENT SIMULATOR FOR ROBOTIC SYSTEMS c63
Kenneth R. Fernandez, George E. Cook (Vanderbilt Univ., Nashville, TN.), Csaba Biegl (Vanderbilt Univ., Nashville, TN.), and James F. Springfield (Vanderbilt Univ., Nashville, TN.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 119-125 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

The purpose of this paper is to present an update of an intelligent robotics simulator package, ROBOSIM, first introduced at Technology 2000 in 1990. ROBOSIM is used for three-dimensional geometrical modeling of robot manipulators and various objects in their workspace, and for the simulation of action sequences performed by the manipulators. Geometric modeling of robot manipulators has an expanding area of interest because it can aid the design and usage of robots in a number of ways, including: design and testing of manipulators, robot action planning, on-line control of robot manipulators, telerobotic user interface, and training and education. NASA developed ROBOSIM between 1985-88 to facilitate the development of robotics, and used the package to develop robotics for welding, coating, and space operations. ROBOSIM has been further developed for academic use by its co-developer Vanderbilt University, and has been in both classroom and laboratory environments for teaching complex robotic concepts. Plans are being formulated to make ROBOSIM available to all U.S. engineering/engineering technology schools (over three hundred total with an estimated 10,000+ users per year). Author

N93-22162*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
A THREE CHANNEL TELEMETRY SYSTEM c17
Jeffery C. Lesho and Harry A. C. Eaton *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 129-136 (For primary document see N93-22149 08-99)
(NASA Order S-92635)
Avail: CASI HC A02/MF A04

A three channel telemetry system intended for biomedical applications is described. The transmitter is implemented in a single chip using a 2 micron BiCMOS processes. The operation of the system and the test results from the latest chip are discussed. One channel is always dedicated to temperature measurement while the other two channels are generic. The generic channels carry information from transducers that are interfaced to the system through on-chip general purpose operational amplifiers. The generic channels have different bandwidths: one from dc to 250 Hz and the other from dc to 1300 Hz. Each generic channel modulates a current controlled oscillator to produce a frequency modulated signal. The two

frequency modulated signals are summed and used to amplitude modulate the temperature signal which acts as a carrier. A near-field inductive link telemeters the combined signals over a short distance. The chip operates on a supply voltage anywhere from 2.5 to 3.6 Volts and draws less than 1 mA when transmitting a signal. The chip can be incorporated into ingestible, implantable and other configurations. The device can free the patient from tethered data collection systems and reduces the possibility of infection from subcutaneous leads. Data telemetry can increase patient comfort leading to a greater acceptance of monitoring. Author

N93-22163*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
AUTOMATED SYSTEM FOR ANALYZING THE ACTIVITY OF INDIVIDUAL NEURONS **c52**
Isaac N. Bankman, Kenneth O. Johnson, Alex M. Menkes, Steve D. Diamond, and David M. OShaughnessy *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 138-145 (For primary document see N93-22149 08-99)
(Contract N00039-91-C-0001; NS-072226)
Avail: CASI HC A02/MF A04

This paper presents a signal processing system that: (1) provides an efficient and reliable instrument for investigating the activity of neuronal assemblies in the brain; and (2) demonstrates the feasibility of generating the command signals of prostheses using the activity of relevant neurons in disabled subjects. The system operates online, in a fully automated manner and can recognize the transient waveforms of several neurons in extracellular neurophysiological recordings. Optimal algorithms for detection, classification, and resolution of overlapping waveforms are developed and evaluated. Full automation is made possible by an algorithm that can set appropriate decision thresholds and an algorithm that can generate templates on-line. The system is implemented with a fast IBM PC compatible processor board that allows on-line operation. Author

N93-22164*# Brookhaven National Lab., Upton, NY. Medical Dept.
IMPROVED INHALATION TECHNOLOGY FOR SETTING SAFE EXPOSURE LEVELS FOR WORKPLACE CHEMICALS **c52**
Bruce O. Stuart *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 146-149 (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

Threshold Limit Values recommended as allowable air concentrations of a chemical in the workplace are often based upon a no-observable-effect-level (NOEL) determined by experimental inhalation studies using rodents. A 'safe level' for human exposure must then be estimated by the use of generalized safety factors in attempts to extrapolate from experimental rodents to man. The recent development of chemical-specific physiologically-based toxicokinetics makes use of measured physiological, biochemical, and metabolic parameters to construct a validated model that is able to 'scale-up' rodent response data to predict the behavior of the chemical in man. This procedure is made possible by recent advances in personal computer software and the emergence of appropriate biological data, and provides an analytical tool for much more reliable risk evaluation and airborne chemical exposure level setting for humans. Author

N93-22165*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
ACTIVE HYDRAZINE VAPOR SAMPLER (AHVS) **c25**
Rebecca C. Young, Charles F. McBrearty (I-NET, Inc., Cocoa Beach, FL.), and Daniel J. Curran (I-NET, Inc., Cocoa Beach, FL.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 153-163 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

The Active Hydrazine Vapor Sampler (AHVS) was developed to detect vapors of hydrazine (HZ) and monomethylhydrazine (MMH) in air at parts-per-billion (ppb) concentration levels. The sampler consists of a commercial personal pump that draws ambient air through paper tape treated with vanillin (4-hydroxy-3-methoxybenzaldehyde). The paper tape is sandwiched in a thin cardboard housing inserted in one of the two specially designed holders to facilitate sampling. Contaminated air reacts with vanillin to develop a yellow color. The density of the color is proportional to the concentration of HZ or MMH. The AHVS can detect 10 ppb in less than 5 minutes. The sampler is easy to use, low cost, and intrinsically safe and contains no toxic material. It is most beneficial for use in locations with no laboratory capabilities for instrumentation calibration. This paper reviews the development, laboratory test, and field test of the device. Author

N93-22166*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
COP IMPROVEMENT OF REFRIGERATOR/FREEZERS, AIR-CONDITIONERS, AND HEAT PUMPS USING NONAZEOTROPIC REFRIGERANT MIXTURES **c31**
Douglas G. Westra *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 164-173 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

With the February, 1992 announcement by President Bush to move the deadline for outlawing CFC (chloro-fluoro-carbon) refrigerants from the year 2000 to the year 1996, the refrigeration and air-conditioning industries have been accelerating their efforts to find alternative refrigerants. Many of the alternative refrigerants being evaluated require synthetic lubricants, are less efficient, and have toxicity problems. One option to developing new, alternative refrigerants is to combine existing non-CFC refrigerants to form a nonazeotropic mixture, with the concentration optimized for the given application so that system COP (Coefficient Of Performance) may be maintained or even improved. This paper will discuss the dilemma that industry is facing regarding CFC phase-out and the problems associated with CFC alternatives presently under development. A definition of nonazeotropic mixtures will be provided, and the characteristics and COP benefits of nonazeotropic refrigerant mixtures will be explained using thermodynamic principles. Limitations and disadvantages of nonazeotropic mixtures will be discussed, and example systems using such mixtures will be reviewed. Author

N93-22167*# Jasper (Louis J., Jr), Fulton, MD.
VARIABLE-VOLUME FLUSHING (V-VF) DEVICE FOR WATER CONSERVATION IN TOILETS **c54**
Louis J. Jasper, Jr. *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 175-179 (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

Thirty five percent of residential indoor water used is flushed down the toilet. Five out of six flushes are for liquid waste only, which requires only a fraction of the water needed for solid waste. Designers of current low-flush toilets (3.5-gal. flush) and ultra-low-flush toilets (1.5-gal. flush) did not consider the vastly reduced amount of water needed to flush liquid waste versus solid waste. Consequently, these toilets are less practical than desired and can be improved upon for water conservation. This paper describes a variable-volume flushing (V-VF) device that is more reliable than the currently used flushing devices (it will not leak), is simple, more economical, and more water conserving (allowing one to choose the amount of water to use for flushing solid and liquid waste). Author

N93-22168*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AUTOMATED REAL-TIME SOFTWARE DEVELOPMENT **c61**
Denise R. Jones, Carrie K. Walker, and John J. Turkovich (Draper, Charles Stark Lab., Inc., Cambridge, MA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 183-193 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

A Computer-Aided Software Engineering (CASE) system has been developed at the Charles Stark Draper Laboratory (CSDL) under the direction of the NASA Langley Research Center. The CSDL CASE tool provides an automated method of generating source code and hard copy documentation from functional application engineering specifications. The goal is to significantly reduce the cost of developing and maintaining real-time scientific and engineering software while increasing system reliability. This paper describes CSDL CASE and discusses demonstrations that used the tool to automatically generate real-time application code. Author

N93-22169*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONSTRAINT CHECKING DURING ERROR RECOVERY c61
Robyn R. Lutz and Johnny S. K. Wong (Iowa State Univ. of Science and Technology, Ames.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 194-203 (For primary document see N93-22149 08-99)
(Grant NGT-50269)
Avail: CASI HC A02/MF A04

The system-level software onboard a spacecraft is responsible for recovery from communication, power, thermal, and computer-health anomalies that may occur. The recovery must occur without disrupting any critical scientific or engineering activity that is executing at the time of the error. Thus, the error-recovery software may have to execute concurrently with the ongoing acquisition of scientific data or with spacecraft maneuvers. This work provides a technique by which the rules that constrain the concurrent execution of these processes can be modeled in a graph. An algorithm is described that uses this model to validate that the constraints hold for all concurrent executions of the error-recovery software with the software that controls the science and engineering activities of the spacecraft. The results are applicable to a variety of control systems with critical constraints on the timing and ordering of the events they control.
Author

N93-22170*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FAILURE ENVIRONMENT ANALYSIS TOOL APPLICATIONS c38
Ginger L. Pack and David B. Wadsworth (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 205-214 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

Understanding risks and avoiding failure are daily concerns for the women and men of NASA. Although NASA's mission propels us to push the limits of technology, and though the risks are considerable, the NASA community has instilled within, the determination to preserve the integrity of the systems upon which our mission and, our employees lives and well-being depend. One of the ways this is being done is by expanding and improving the tools used to perform risk assessment. The Failure Environment Analysis Tool (FEAT) was developed to help engineers and analysts more thoroughly and reliably conduct risk assessment and failure analysis. FEAT accomplishes this by providing answers to questions regarding what might have caused a particular failure; or, conversely, what effect the occurrence of a failure might have on an entire system. Additionally, FEAT can determine what common causes could have resulted in other combinations of failures. FEAT will even help determine the vulnerability of a system to failures, in light of reduced capability. FEAT also is useful in training personnel who must develop an understanding of particular systems. FEAT facilitates training on system behavior, by providing an automated environment in which to conduct 'what-if' evaluation. These types of analyses make FEAT a valuable tool for engineers and operations personnel in the design, analysis, and operation of NASA space systems.
Author

N93-22171*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF INTERACTIVE MULTIMEDIA APPLICATIONS c82
Albert Leigh (McDonnell-Douglas Space Systems Co., Houston, TX.) and Lui Wang *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 217-225 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

Multimedia is making an increasingly significant contribution to our informational society. The usefulness of this technology is already evident in education, business presentations, informational kiosks (e.g., in museums), training and the entertainment environment. Institutions, from grade schools to medical schools, are exploring the use of multifaceted electronic text books and teaching aids to enhance course materials. Through multimedia, teachers and students can take full advantage of the cognitive value of animation, audio, video and other types in a seamless application. The Software Technology Branch at NASA Johnson Space Center (NASA/JSC) is taking similar approaches to apply the state-of-the-art technology to space training, mission operations and other applications. This paper discusses the characteristics and development of multimedia applications at the NASA/JSC.
Author

N93-22172*# Naval Undersea Warfare Center, Newport, RI. Missiles Div.
MICRO-VIDEO DISPLAY WITH OCULAR TRACKING AND INTERACTIVE VOICE CONTROL c60
James E. Miller *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 227-234 Prepared for Foster-Miller Associates, Inc., Waltham, MA (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

In certain space-restricted environments, many of the benefits resulting from computer technology have been foregone because of the size, weight, inconvenience, and lack of mobility associated with existing computer interface devices. Accordingly, an effort to develop a highly miniaturized and 'wearable' computer display and control interface device, referred to as the Sensory Integrated Data Interface (SIDI), is underway. The system incorporates a micro-video display that provides data display and ocular tracking on a lightweight headset. Software commands are implemented by conjunctive eye movement and voice commands of the operator. In this initial prototyping effort, various 'off-the-shelf' components have been integrated into a desktop computer and with a customized menu-tree software application to demonstrate feasibility and conceptual capabilities. When fully developed as a customized system, the interface device will allow mobile, 'hand-free' operation of portable computer equipment. It will thus allow integration of information technology applications into those restrictive environments, both military and industrial, that have not yet taken advantage of the computer revolution. This effort is Phase 1 of Small Business Innovative Research (SBIR) Topic number N90-331 sponsored by the Naval Undersea Warfare Center Division, Newport. The prime contractor is Foster-Miller, Inc. of Waltham, MA.
Author

N93-22173*# Idaho National Engineering Lab., Idaho Falls.
VIDEO CONFERENCING MADE EASY c32
D. Gail Larsen and Paul R. Schwieder *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 235-241 (For primary document see N93-22149 08-99)
(Contract DE-AC07-76ID-01570)
Avail: CASI HC A02/MF A04

Network video conferencing is advancing rapidly throughout the nation, and the Idaho National Engineering Laboratory (INEL), a Department of Energy (DOE) facility, is at the forefront of the development. Engineers at INEL/EG&G designed and installed a very unique DOE videoconferencing system, offering many outstanding features, that include true multipoint conferencing, user-friendly design and operation with no full-time operators required, and the potential for cost effective expansion of the system. One area where INEL/EG&G engineers made a significant contribution to video conferencing was in the development of effective, user-friendly, end station driven scheduling software. A PC at each user site is used to schedule conferences via a windows package. This software interface provides information to the users concerning conference availability, scheduling, initiation, and termination. The menus are 'mouse' controlled. Once a conference is scheduled, a workstation at the hubs monitors the network to initiate all scheduled conferences. No active operator participation is required once a user schedules a conference through the local PC; the workstation automatically initiates and terminates the conference as scheduled. As each conference is scheduled, hard copy notification is also printed at each participating site. Video conferencing is the wave of the future. The use of these user-friendly systems will save millions in lost productivity and travel cost throughout the nation. The ease of operation and conference scheduling will play a key role on the extent industry uses this new technology. The INEL/EG&G has developed a prototype scheduling system for both commercial and federal government use.
Author

N93-22174*# Allied-Signal Corp., Kansas City, MO.
INTEGRATED FLEXIBLE MANUFACTURING PROGRAM FOR MANUFACTURING AUTOMATION AND RAPID PROTOTYPING c31
S. L. Brooks, C. W. Brown, M. S. King, W. R. Simons, and J. J. Zimmerman *In* NASA, Washington, Technology 2002: The Third National

Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 245-253 (For primary document see N93-22149 08-99)
(Contract DE-AC04-76DP-00613)
Avail: CASI HC A02/MF A04

The Kansas City Division of Allied Signal Inc., as part of the Integrated Flexible Manufacturing Program (IFMP), is developing an integrated manufacturing environment. Several systems are being developed to produce standards and automation tools for specific activities within the manufacturing environment. The Advanced Manufacturing Development System (AMDS) is concentrating on information standards (STEP) and product data transfer; the Expert Cut Planner system (XCUT) is concentrating on machining operation process planning standards and automation capabilities; the Advanced Numerical Control system (ANC) is concentrating on NC data preparation standards and NC data generation tools; the Inspection Planning and Programming Expert system (IPPEX) is concentrating on inspection process planning, coordinate measuring machine (CMM) inspection standards and CMM part program generation tools; and the Intelligent Scheduling and Planning System (ISAPS) is concentrating on planning and scheduling tools for a flexible manufacturing system environment. All of these projects are working together to address information exchange, standardization, and information sharing to support rapid prototyping in a Flexible Manufacturing System (FMS) environment. Author

N93-22175*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTOMATED FIBER PLACEMENT COMPOSITE MANUFACTURING: THE MISSION AT MSFC'S PRODUCTIVITY ENHANCEMENT COMPLEX c31
John H. Vickers and Larry I. Pelham (Thiokol Corp., Huntsville, AL.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 255-261 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

Automated fiber placement is a manufacturing process used for producing complex composite structures. It is a notable leap to the state-of-the-art in technology for automated composite manufacturing. The fiber placement capability was established at the Marshall Space Flight Center's (MSFC) Productivity Enhancement Complex in 1992 in collaboration with Thiokol Corporation to provide materials and processes research and development, and to fabricate components for many of the Center's Programs. The Fiber Placement System (FPX) was developed as a distinct solution to problems inherent to other automated composite manufacturing systems. This equipment provides unique capabilities to build composite parts in complex 3-D shapes with concave and other asymmetrical configurations. Components with complex geometries and localized reinforcements usually require labor intensive efforts resulting in expensive, less reproducible components; the fiber placement system has the features necessary to overcome these conditions. The mechanical systems of the equipment have the motion characteristics of a filament winder and the fiber lay-up attributes of a tape laying machine, with the additional capabilities of differential tow payout speeds, compaction and cut-restart to selectively place the correct number of fibers where the design dictates. This capability will produce a repeatable process resulting in lower cost and improved quality and reliability. Author

N93-22176*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LEARNING CHARACTERISTICS OF A SPACE-TIME NEURAL NETWORK AS A TETHER SKIPROPE OBSERVER c18
Robert N. Lea, James A. Villarreal, Yashvant Jani (Togai InfraLogic, Inc., Houston, TX.), and Charles Copeland (Loral Space Information Systems, Houston, TX.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 262-273 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

The Software Technology Laboratory at the Johnson Space Center is testing a Space Time Neural Network (STNN) for observing tether oscillations present during retrieval of a tethered satellite. Proper identification of tether oscillations, known as 'skiprope' motion, is vital to safe retrieval of the tethered satellite. Our studies indicate that STNN has certain learning characteristics that must be understood properly to utilize this type of neural network for the tethered satellite problem. We present our findings on the learning characteristics including a learning rate versus momentum performance table. Author

N93-22177*# Wilton Industries, Inc., Ridgefield, CT.
WIRELESS INFRARED COMMUNICATIONS FOR SPACE AND TERRESTRIAL APPLICATIONS c32
James W. Crimmins *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 277-280 (For primary document see N93-22149 08-99)
Avail: CASI HC A01/MF A04

Voice and data communications via wireless (and fiberless) optical means has been commonplace for many years. However, continuous advances in optoelectronics and microelectronics have resulted in significant advances in wireless optical communications over the last decade. Wilton has specialized in diffuse infrared voice and data communications since 1979. In 1986, NASA Johnson Space Center invited Wilton to apply its wireless telecommunications and factory floor technology to astronaut voice communications aboard the shuttle. In September, 1988 a special infrared voice communications system flew aboard a 'Discovery' Shuttle mission as a flight experiment. Since then the technology has been further developed, resulting in a general purpose of 2Mbs wireless voice/data LAN which has been tested for a variety of applications including use aboard Spacelab. Funds for Wilton's wireless IR development were provided in part by NASA's Technology Utilization Office and by the NASA Small Business Innovative Research Program. As a consequence, Wilton's commercial product capability has been significantly enhanced to include diffuse infrared wireless LAN's as well as wireless infrared telecommunication systems for voice and data. Author

N93-22178*# Harris Corp., Palm Bay, FL.
FLEXIBLE HIGH SPEED CODEC c33
James V. Wernlund *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 281-288 (For primary document see N93-22149 08-99)
(Contract NAS3-25087)
Avail: CASI HC A02/MF A04

HARRIS, under contract with NASA Lewis, has developed a hard decision BCH (Bose-Chaudhuri-Hocquenghem) triple error correcting block CODEC ASIC, that can be used in either a bursted or continuous mode. the ASIC contains both encoder and decoder functions, programmable lock thresholds, and PSK related functions. The CODEC provides up to 4 dB of coding gain for data rates up to 300 Mbps. The overhead is selectable from 7/8 to 15/16 resulting in minimal band spreading, for a given BER. Many of the internal calculations are brought out enabling the CODEC to be incorporated in more complex designs. The ASIC has been tested in BPSK, QPSK and 16-ary PSK link simulators and found to perform to within 0.1 dB of theory for BER's of 10(exp -2) to 10(exp -9). The ASIC itself, being a hard decision CODEC, is not limited to PSK modulation formats. Unlike most hard decision CODEC's, the HARRIS CODEC doesn't upgrade BER performance significantly at high BER's but rather becomes transparent. Author

N93-22179*# Army Research Lab., Fort Monmouth, NJ.
ULTRA-STABLE, LOW PHASE NOISE DIELECTRIC RESONATOR STABILIZED OSCILLATORS FOR MILITARY AND COMMERCIAL SYSTEMS c33
Muhammad Mizan, Thomas Higgins, and Dana Sturzebecher *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 289-295 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

EPSD has designed, fabricated and tested, ultra-stable, low phase noise microwave dielectric resonator oscillators (DRO's) at S, X, Ku, and K-bands, for potential application to high dynamic range and low radar cross section target detection radar systems. The phase noise and the temperature stability surpass commercially available DROs. Low phase noise signals are critical for CW Doppler radars, at both very close-in and large offset frequencies from the carrier. The oscillators were built without any temperature compensation techniques and exhibited a temperature stability of 25 parts per million (ppm) over an extended temperature range. The oscillators are lightweight, small and low cost compared to BAW & SAW oscillators, and can impact commercial systems such as telecommunications,

built-in-test equipment, cellular phone and satellite communications systems. The key to obtaining this performance was a high Q factor resonant structure (RS) and careful circuit design techniques. The high Q RS consists of a dielectric resonator (DR) supported by a low loss spacer inside a metal cavity. The S and the X-band resonant structures demonstrated loaded Q values of 20,300 and 12,700, respectively. Author

N93-22180*# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.

EXCIMER LASER PROCESSING OF BACKSIDE-ILLUMINATED CCDS **c36**

S. D. Russell *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 296-303 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

An excimer laser is used to activate previously implanted dopants on the backside of a backside-illuminated CCD. The controlled ion implantation of the backside and subsequent thin layer heating and recrystallization by the short wavelength pulsed excimer laser simultaneously activates the dopant and anneals out implant damage. This improves the dark current response, repairs defective pixels and improves spectral response. This process heats a very thin layer of the material to high temperatures on a nanosecond time scale while the bulk of the delicate CCD substrate remains at low temperature. Excimer laser processing backside-illuminated CCD's enables salvage and utilization of otherwise nonfunctional components by bringing their dark current response to within an acceptable range. This process is particularly useful for solid state imaging detectors used in commercial, scientific and government applications requiring a wide spectral response and low light level detection. Author

N93-22181*# Agricultural Research Service, New Orleans, LA.

APPLICATIONS OF FIBROUS SUBSTRATES CONTAINING INSOLUBILIZED PHASE CHANGE POLYMERS **c37**

Tyrone L. Vigo and Joseph S. Bruno *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 307-316 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

Incorporation of polyethylene glycols into fibrous substrates produces several improved functional properties when they are insolubilized by crosslinking with a methylolamide resin or by polyacetal formation by their reaction with glyoxal. The range of molecular weights of polyols that may be insolubilized is broad as are the curing conditions (0.25-10 min at 80-200C). Most representative fiber types and blends (natural and synthetic) and all types of fabric constructions (woven, nonwoven and knit) have been modified by incorporation of the bound polyols. The most novel property is the thermal adaptability of the modified substrates to many climatic conditions. This adaptability is due to the high latent heat of the crosslinked polyols that function as phase change materials, the hydrophilic nature of the crosslinked polymer and its enhanced thermal conductivity. Other enhanced properties imparted to fabrics include flex and flat abrasion, antimicrobial activity, reduced static charge, resistance to oily soils, resiliency, wind resistance and reduced lint loss. Applications commercialized in the U.S. and Japan include sportswear and skiwear. Several examples of electric sets of properties useful for specific end uses are given. In addition, other uses are biomedical horticultural, aerospace, indoor insulation, automotive interiors and components and packaging material. Author

N93-22182*# Army Belvoir Research and Development Center, Fort Belvoir, VA.

RUST TRANSFORMATION/RUST COMPATIBLE PRIMERS **c27**

Dario A. Emeric and Christopher E. Miller *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 317-323 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

Proper surface preparation has been the key to obtain good performance by a surface coating. The major obstacle in preparing a corroded or rusted surface is the complete removal of the contaminants and the corrosion products. Sandblasting has been traditionally used to remove the corrosion products before painting. However, sandblasting can be expensive, may be prohibited by local health regulations and is not applicable in every situation. To get around these obstacles, Industry developed rust converters/rust transformers and rust compatible primers (high solids epoxies). The potential use of these products for military equipment led personnel of the Belvoir Research, Development and Engineering Center (BRDEC) to evaluate the commercially available rust transformers and rust compatible primers. Prior laboratory experience with commercially available rust converters, as well as field studies in Hawaii and Puerto Rico, revealed poor performance, several inherent limitations, and lack of reliability. It was obvious from our studies that the performance of rust converting products was more dependent on the amount and type of rust present, as well as the degree of permeability of the coating, than on the product's ability to form an organometallic complex with the rust. Based on these results, it was decided that the Military should develop their own rust converter formulation and specification. The compound described in the specification is for use on a rusted surface before the application of an organic coating (bituminous compounds, primer or topcoat). These coatings should end the need for sandblasting or the removing of the adherent corrosion products. They also will prepare the surface for the application of the organic coating. Several commercially available rust compatible primers (RCP) were also tested using corroded surfaces. All of the evaluated RCP failed our laboratory tests for primers. Author

N93-22183*# Oak Ridge National Lab., TN.

METHODS FOR PREDICTING PROPERTIES AND TAILORING SALT SOLUTIONS FOR INDUSTRIAL PROCESSES **c25**

Moonis R. Ally *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 324-329 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

An algorithm developed at Oak Ridge National Laboratory accurately and quickly predicts thermodynamic properties of concentrated aqueous salt solutions. This algorithm is much simpler and much faster than other modeling schemes and is unique because it can predict solution behavior at very high concentrations and under varying conditions. Typical industrial applications of this algorithm would be in manufacture of inorganic chemicals by crystallization, thermal storage, refrigeration and cooling, extraction of metals, emissions controls, etc. Author

N93-22184*# Sverdrup Technology, Inc., Bay Saint Louis, MS.

AN X RAY SCATTER APPROACH FOR NON-DESTRUCTIVE CHEMICAL ANALYSIS OF LOW ATOMIC NUMBERED ELEMENTS **c72**

H. Richard Ross *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 330-339 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

A non-destructive x-ray scatter (XRS) approach has been developed, along with a rapid atomic scatter algorithm for the detection and analysis of low atomic-numbered elements in solids, powders, and liquids. The present method of energy dispersive x-ray fluorescence spectroscopy (EDXRF) makes the analysis of light elements (i.e., less than sodium; less than 11) extremely difficult. Detection and measurement become progressively worse as atomic numbers become smaller, due to a competing process called 'Auger Emission', which reduces fluorescent intensity, coupled with the high mass absorption coefficients exhibited by low energy x-rays, the detection and determination of low atomic-numbered elements by x-ray spectrometry is limited. However, an indirect approach based on the intensity ratio of Compton and Rayleigh scattered has been used to define light element components in alloys, plastics and other materials. This XRS technique provides qualitative and quantitative information about the overall constituents of a variety of samples. Author

N93-22185*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

AN ARTIFICIAL INTELLIGENCE-BASED STRUCTURAL HEALTH MONITORING SYSTEM FOR AGING AIRCRAFT **c63**

Joseph E. Grady, Stanley S. Tang (Structural Integrity Associates, Inc., San Jose, CA.), and K. L. Chen (Structural Integrity Associates, Inc., San Jose, CA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 343-351 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

To reduce operating expenses, airlines are now using the existing fleets

of commercial aircraft well beyond their originally anticipated service lives. The repair and maintenance of these 'aging aircraft' has therefore become a critical safety issue, both to the airlines and the Federal Aviation Administration. This paper presents the results of an innovative research program to develop a structural monitoring system that will be used to evaluate the integrity of in-service aerospace structural components. Currently in the final phase of its development, this monitoring system will indicate when repair or maintenance of a damaged structural component is necessary. Author

N93-22186*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

REACTIVE CONTROL AND REASONING ASSISTANCE FOR SCIENTIFIC LABORATORY INSTRUMENTS **c63**

David E. Thompson, Richard Levinson, and Peter Robinson *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 353-363 (For primary document see N93-22149 08-99)

Avail: CASI HC A03/MF A04

Scientific laboratory instruments that are involved in chemical or physical sample identification frequently require substantial human preparation, attention, and interactive control during their operation. Successful real-time analysis of incoming data that supports such interactive control requires: (1) a clear recognition of variance of the data from expected results; and (2) rapid diagnosis of possible alternative hypotheses which might explain the variance. Such analysis then aids in decisions about modifying the experiment protocol, as well as being a goal itself. This paper reports on a collaborative project at the NASA Ames Research Center between artificial intelligence researchers and planetary microbial ecologists. Our team is currently engaged in developing software that autonomously controls science laboratory instruments and that provides data analysis of the real-time data in support of dynamic refinement of the experiment control. the first two instruments to which this technology has been applied are a differential thermal analyzer (DTA) and a gas chromatograph (GC). coupled together, they form a new geochemicstry and microbial analysis tool that is capable of rapid identification of the organiz and mineralogical constituents in soils. The thermal decomposition of the minerals and organics, and the attendance release of evolved gases, provides data about the structural and molecular chemistry of the soil samples. Author

N93-22187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

KNOWLEDGE FROM PICTURES (KFP) **c63**

Walt Truszkowski, Frank Paterra (Computer Technology Associates, Inc., Rockville, MD.), and Sidney Bailin (Computer Technology Associates, Inc., Rockville, MD.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 364-373 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

The old maxim goes: 'A picture is worth a thousand words'. The objective of the research reported in this paper is to demonstrate this idea as it relates to the knowledge acquisition process and the automated development of an expert system's rule base. A prototype tool, the Knowledge From Pictures (KFP) tool, has been developed which configures an expert system's rule base by an automated analysis of and reasoning about a 'picture', i.e., a graphical representation of some target system to be supported by the diagnostic capabilities of the expert system under development. This rule base, when refined, could then be used by the expert system for target system monitoring and fault analysis in an operational setting. Most people, when faced with the problem of understanding the behavior of a complicated system, resort to the use of some picture or graphical representation of the system as an aid in thinking about it. This depiction provides a means of helping the individual to visualize the bahavior and dynamics of the system under study. An analysis of the picture augmented with the individual's background information, allows the problem solver to codify knowledge about the system. This knowledge can, in turn, be used to develop computer programs to automatically monitor the system's performance. The approach taken is this research was to mimic this knowledge acquisition paradigm. A prototype tool was developed which provides the user: (1) a mechanism for graphically representing sample system-configurations appropriate for the domain, and (2) a linguistic device for annotating the graphical representation with the behaviors and mutual influences of the components depicted in the graphic. The KFP tool, reasoning from the graphical depiction along with user-supplied annotations of component behaviors and inter-component influences, generates a rule base that could be used in automating the fault detection, isolation, and repair of the system. Author

N93-22188*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

OPTIMAL DESIGN OF COMPOSITE HIP IMPLANTS USING NASA TECHNOLOGY **c52**

T. A. Blake (Case Western Reserve Univ., Cleveland, OH.), D. A. Saravanos, D. T. Davy (Case Western Reserve Univ., Cleveland, OH.), S. A. Waters (Case Western Reserve Univ., Cleveland, OH.), and D. A. Hopkins *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 377-386 (For primary document see N93-22149 08-99)

(Grant NAG3-1027)

Avail: CASI HC A02/MF A04

Using an adaptation of NASA software, we have investigated the use of numerical optimization techniques for the shape and material optimization of fiber composite hip implants. The original NASA inhouse codes, were originally developed for the optimization of aerospace structures. The adapted code, which was called OPORIM, couples numerical optimization algorithms with finite element analysis and composite laminate theory to perform design optimization using both shape and material design variables. The external and internal geometry of the implant and the surrounding bone is described with quintic spline curves. This geometric representation is then used to create an equivalent 2-D finite element model of the structure. Using laminate theory and the 3-D geometric information, equivalent stiffnesses are generated for each element of the 2-D finite element model, so that the 3-D stiffness of the structure can be approximated. The geometric information to construct the model of the femur was obtained from a CT scan. A variety of test cases were examined, incorporating several implant constructions and design variable sets. Typically the code was able to produce optimized shape and/or material parameters which substantially reduced stress concentrations in the bone adjacent of the implant. The results indicate that this technology can provide meaningful insight into the design of fiber composite hip implants. Author

N93-22189*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

FINITE ELEMENT ANALYSIS OF A COMPOSITE ARTIFICIAL ANKLE **c52**

Leigh Ann Perkins, Lawrence Johnston, Charles Denniston, and Blaise E. Czekalski (Intergraph Corp., Madison, AL.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 387-389 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

Ultra-light carbon fiber composite materials are being utilized in artificial limbs with increasing frequency in recent years. Dr. Arthur Copes, an orthotist from Baton Rouge, Louisiana, has developed a graphite expoxy composite material artificial ankle (Copes/Bionic Ankle) that is intended to be used by amputees who require the most advanced above-and-below-the-knee prosthetic devices. The Copes/Bionic Ankle is designed to reproduce the function of the natural ankle joint by allowing the composite material to act as a spring mechanism without the use of metal mechanical parts. NASA Marshall Space Flight Center has agreed to participate in the design effort by providing the structural analysis of the artificial ankle design. Author

N93-22190*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

DESIGN OF A PORTABLE POWERED SEAT LIFT **c54**

Bruce Weddendorf *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 390-396 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

People suffering from degenerative hip or knee joints find sitting and rising from a seated position very difficult. These people can rely on large stationary chairs at home, but must ask others for assistance when rising from any other chair. An orthopedic surgeon identified to the MSFC

Technology Utilization Office the need for development of a portable device that could perform a similar function to the stationary lift chairs. The MSFC Structural Development Branch answered the Technology Utilization Office's request for design of a portable powered seat lift. The device is a seat cushion that opens under power, lifting the user to near-standing positions. The largest challenge was developing a mechanism to provide a stable lift over the large range of motion needed, and fold flat enough to be comfortable to sit on. CAD 3-D modeling was used to generate complete drawings for the prototype, and a full-scale working model of the Seat lift was made based on the drawings. The working model is of low strength, but proves the function of the mechanism and the concept. Author

N93-22191*# General Engineering and Systems Analysis Co., Inc., Kearneysville, WV.
MICROCOMPUTER BASED SOFTWARE FOR BIODYNAMIC SIMULATION **c54**
N. Rangarajan and T. Shams *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 397-405 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

This paper presents a description of a microcomputer based software package, called DYNAMAN, which has been developed to allow an analyst to simulate the dynamics of a system consisting of a number of mass segments linked by joints. One primary application is in predicting the motion of a human occupant in a vehicle under the influence of a variety of external forces, specially those generated during a crash event. Extensive use of a graphical user interface has been made to aid the user in setting up the input data for the simulation and in viewing the results from the simulation. Among its many applications, it has been successfully used in the prototype design of a moving seat that aids in occupant protection during a crash, by aircraft designers in evaluating occupant injury in airplane crashes, and by users in accident reconstruction for reconstructing the motion of the occupant and correlating the impacts with observed injuries. Author

N93-22192*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE DATA EGG: A NEW SOLUTION TO TEXT ENTRY BARRIERS **c82**
Gary L. Friedman *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 409-418 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

A unit that allows text entry with only one hand has been developed, and holds the promise of allowing computers to be truly portable. It is unique in that it allows operation in any position, freeing the user from the traditional constraints of having to be seated near a desk. This hand held, chord-key-based unit can be used either autonomously for idea capturing, or tethered to a personal computer and used as an auxiliary keyboard. Astronauts, journalists, the bedridden, and anyone else normally barred from using a computer while on the job could also benefit from this form of man-machine interface, which has been dubbed the 'Data Egg'. Author

N93-22193*# General Electric Co., Houston, TX. Government Services.
MIRAGE: THE DATA ACQUISITION, ANALYSIS, AND DISPLAY SYSTEM **c82**
Robert S. Rosser and Hasan H. Rahman *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 419-428 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

Developed for the NASA Johnson Space Center and Life Sciences Directorate by GE Government Services, the Microcomputer Integrated Real-time Acquisition Ground Equipment (MIRAGE) system is a portable ground support system for Spacelab life sciences experiments. The MIRAGE system can acquire digital or analog data. Digital data may be NRZ-formatted telemetry packets of packets from a network interface. Analog signal are digitized and stored in experimental packet format. Data packets from any acquisition source are archived to a disk as they are received. Meta-parameters are generated from the data packet parameters by applying mathematical and logical operators. Parameters are displayed in text and graphical form or output to analog devices. Experiment data packets may be retransmitted through the network interface. Data stream definition, experiment parameter format, parameter displays, and other variables are configured using spreadsheet database. A database can be developed to support virtually any data packet format. The user interface provides menu- and icon-driven program control. The MIRAGE system can be integrated with other workstations to perform a variety of functions. The generic capabilities, adaptability and ease of use make the MIRAGE a cost-effective solution to many experimental data processing requirements. Author

N93-22194*# Laboratory for Physical Sciences, College Park, MD.
TUNNELING MAGNETIC FORCE MICROSCOPY **c76**
Edward R. Burke, Romel D. Gomez (Maryland Univ., College Park.), Amr A. Adly (Maryland Univ., College Park.), and Isaak D. Mayergoyz (Maryland Univ., College Park.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 429-438 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

We have developed a powerful new tool for studying the magnetic patterns on magnetic recording media. This was accomplished by modifying a conventional scanning tunneling microscope. The fine-wire probe that is used to image surface topography was replaced with a flexible magnetic probe. Images obtained with these probes reveal both the surface topography and the magnetic structure. We have made a thorough theoretical analysis of the interaction between the probe and the magnetic fields emanating from a typical recorded surface. Quantitative data about the constituent magnetic fields can then be obtained. We have employed these techniques in studies of two of the most important issues of magnetic record: data overwrite and maximizing data-density. These studies have shown: (1) overwritten data can be retrieved under certain conditions; and (2) improvements in data-density will require new magnetic materials. In the course of these studies we have developed new techniques to analyze magnetic fields of recorded media. These studies are both theoretical and experimental and combined with the use of our magnetic force scanning tunneling microscope should lead to further breakthroughs in the field of magnetic recording. Author

N93-22195*# Naval Command, Control and Ocean Surveillance Center, San Diego, CA. Research, Development, Test and Evaluation Div.
OPERATOR PERFORMANCE SUPPORT SYSTEM (OPSS) **c54**
Marlen Z. Conklin (Nova Univ., Dania, FL.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 439-444 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

In the complex and fast reaction world of military operations, present technologies, combined with tactical situations, have flooded the operator with assorted information that he is expected to process instantly. As technologies progress, this flow of data and information have both guided and overwhelmed the operator. However, the technologies that have confounded many operators today can be used to assist him -- thus the Operator Performance Support Team. In this paper we propose an operator support station that incorporates the elements of Video and Image Databases, productivity Software, Interactive Computer Based Training, Hypertext/Hypermedia Databases, Expert Programs, and Human Factors Engineering. The Operator Performance Support System will provide the operator with an integrating on-line information/knowledge system that will guide expert or novice to correct systems operations. Although the OPSS is being developed for the Navy, the performance of the workforce in today's competitive industry is of major concern. The concepts presented in this paper which address ASW systems software design issues are also directly applicable to industry. the OPSS will propose practical applications in how to more closely align the relationships between technical knowledge and equipment operator performance. Author

N93-22196*# National Aeronautics and Space Administration, Washington, DC.
A NEW TECHNOLOGY FOR MANUFACTURING SCHEDULING DERIVED FROM SPACE SYSTEM OPERATIONS **c31**
R. S. Hornstein and J. K. Willoughby (Avyx, Inc., Englewood, CO.) *In its* Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 447-453 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

A new technology for producing finite capacity schedules has been developed in response to complex requirements for operating space systems such as the Space Shuttle, the Space Station, and the Deep Space Network for telecommunications. This technology has proven its effectiveness in manufacturing environments where popular scheduling techniques associated with Materials Resources Planning (MRPII) and with factory simulation are not adequate for shop-floor work planning and control. The technology has three components. The first is a set of data structures that accommodate an extremely general description of a factory's resources, its manufacturing activities, and the constraints imposed by the environment. The second component is a language and set of software utilities that enable a rapid synthesis of functional capabilities. The third component is an algorithmic architecture called the Five Ruleset Model which accommodates the unique needs of each factory. Using the new technology, systems can model activities that generate, consume, and/or obligate resources. This allows work-in-process (WIP) to be generated and used; it permits constraints to be imposed or intermediate as well as finished goods inventories. It is also possible to match as closely as possible both the current factory state and future conditions such as promise dates. Schedule revisions can be accommodated without impacting the entire production schedule. Applications have been successful in both discrete and process manufacturing environments. The availability of a high-quality finite capacity production planning capability enhances the data management capabilities of MRP II systems. These schedules can be integrated with shop-floor data collection systems and accounting systems. Using the new technology, semi-custom systems can be developed at costs that are comparable to products that do not have equivalent functional capabilities and/or extensibility. Author

N93-22197*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THREE-DIMENSIONAL LASER WINDOW FORMATION FOR INDUSTRIAL APPLICATION **c36**

Vincent G. Verhoff and David Kowalski *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 454-459 (For primary document see N93-22149 08-99)

Avail: CASI HC A04/MF A04

The NASA Lewis Research Center has developed and implemented a unique process for forming flawless three-dimensional, compound-curvature laser windows to extreme accuracies. These windows represent an integral component of specialized nonintrusive laser data acquisition systems that are used in a variety of compressor and turbine research testing facilities. These windows are molded to the flow surface profile of turbine and compressor casings and are required to withstand extremely high pressures and temperatures. This method of glass formation could also be used to form compound-curvature mirrors that would require little polishing and for a variety of industrial applications, including research view ports for testing devices and view ports for factory machines with compound-curvature casings. Currently, sodium-alumino-silicate glass is recommended for three-dimensional laser windows because of its high strength due to chemical strengthening and its optical clarity. This paper discusses the main aspects of three-dimensional laser window formation. It focuses on the unique methodology and the peculiarities that are associated with the formation of these windows. Author

N93-22198*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

HIGH PERFORMANCE SAPPHIRE WINDOWS **c36**

Stephen C. Bates (Advanced Fuel Research, Inc., East Hartford, CT.) and Larry Liou *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 460-469 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

High-quality, wide-aperture optical access is usually required for the advanced laser diagnostics that can now make a wide variety of non-intrusive measurements of combustion processes. Specially processed and mounted sapphire windows are proposed to provide this optical access to extreme environment. Through surface treatments and proper thermal stress design, single crystal sapphire can be a mechanically equivalent replacement for high strength steel. A prototype sapphire window and mounting system have been developed in a successful NASA SBIR Phase 1 project. A large and reliable increase in sapphire design strength (as much as 10x) has been achieved, and the initial specifications necessary for these gains have been defined. Failure testing of small windows has conclusively demonstrated the increased sapphire strength, indicating that a nearly flawless surface polish is the primary cause of strengthening, while an unusual mounting arrangement also significantly contributes to a larger effective strength. Phase 2 work will complete specification and demonstration of these windows, and will fabricate a set for use at NASA. The enhanced capabilities of these high performance sapphire windows will lead to many diagnostic capabilities not previously possible, as well as new applications for sapphire. Author

N93-22199*# ARRAL Industries, Inc., Ontario, CA.

A DUAL OUTPUT PRESSURE, HIGH RELIABILITY, LONG STORAGE LIFE GAS DELIVERY VESSEL ASSEMBLY **c37**

Isaac Maya, Joe McKee, and Rajiv Rajpurkar *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 470-474 (For primary document see N93-22149 08-99)

Avail: CASI HC A01/MF A04

A Gas Vessel Assembly has been developed that delivers purified, very low moisture content gas at two different output pressures. High pressure gas is delivered at up to 6,700 psi, and low pressure gas regulated to 130 psi is also delivered via a second outlet over a wide range of flow rates. The device is extremely lightweight (less than 1 lb) and compact, affords maximum mechanical integrity, high reliability (0.9999 at 95 percent confidence level), and offers extremely long storage life. Specialized design and fabrication techniques are employed that guarantee gas purity and negligible leakage for more than 20 years, in widely varying conditions of storage temperature, humidity, altitude, and vibration environments. The technology offers unique advantages in fast, high pressure discharge applications. For example, when combined with a cryostat, cryogenic temperatures can be achieved such as those used in missile seeker technology. The technology has many additional applications such as: emergency power sources for safety devices such as those needed in nuclear power plants, refineries, collision cushioning devices, superconductor cooling devices, emergency egress systems, miniature mechanical devices that employ gas bearings, and other areas where long storage, extremely high reliability and/or high energy density sources are required. Author

N93-22200*# Axiomatics Corp., Woburn, MA.

ON-LINE PROCESS ANALYSIS INNOVATION: DICOMP (TM) SHUNTING DIELECTRIC SENSOR TECHNOLOGY **c33**

Craig R. Davis and Frank A. Waldman *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 477-484 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

The DiComp Shunting Dielectric Sensor (SDS) is a new patent-pending technology developed under the Small Business Innovation Research Program (SBIR) for NASA's Kennedy Space Center. The incorporation of a shunt electrode into a conventional fringing field dielectric sensor makes the SDS uniquely sensitive to changes in material dielectric properties in the KHz to MHz range which were previously detectable only at GHz measurement frequencies. The initial NASA application of the SDS for Nutrient Delivery Control has demonstrated SDS capabilities for thickness and concentration measurement of Hoagland nutrient solutions. The commercial introduction of DiComp SDS technology for concentration and percent solids measurements in dispersions, emulsions and solutions represents a new technology for process measurements for liquids in a variety of industries. Author

N93-22201*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A MODULAR, PROGRAMMABLE MEASUREMENT SYSTEM FOR PHYSIOLOGICAL AND SPACEFLIGHT APPLICATIONS **c35**

John W. Hines, Robert D. Ricks (Sverdrup Technology, Inc., Moffett Field, CA.), and Christopher J. Miles (Sverdrup Technology, Inc., Moffett Field, CA.) *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 485-493 (For primary document see N93-22149 08-99)

Avail: CASI HC A02/MF A04

The NASA-Ames Sensors 2000! Program has developed a small, compact, modular, programmable, sensor signal conditioning and measurement system, initially targeted for Life Sciences Spaceflight Programs. The system consists of a twelve-slot, multi-layer, distributed function backplane, a digital microcontroller/memory subsystem, conditioned and isolated power supplies, and six application-specific, physiological signal conditioners. Each signal condition is capable of being programmed for gains, offsets, calibration and operate modes, and, in some cases, selectable outputs and functional modes. Presently, the system has the capability for measuring ECG, EMG, EEG, Temperature, Respiration, Pressure, Force, and Acceleration parameters, in physiological ranges. The measurement system makes heavy use of surface-mount packaging technology, resulting in plug in modules sized 125x55 mm. The complete 12-slot system is contained within a volume of 220x150x70mm. The system's capabilities extend well beyond the specific objectives of NASA programs. Indeed, the potential commercial uses of the technology are virtually limitless. In addition to applications in medical and biomedical sensing, the system might also be used in process control situations, in clinical or research environments, in general instrumentation systems, factory processing, or any other applications where high quality measurements are required. Author

N93-22202*# Sverdrup Technology, Inc., Bay Saint Louis, MS.
PREDICTIVE SENSOR METHOD AND APPARATUS **c35**
Vivien J. Cambridge and Thomas L. Koger *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 494-500 (For primary document see N93-22149 08-99)
Avail: CASI HC A02/MF A04

A microprocessor and electronics package employing predictive methodology was developed to accelerate the response time of slowly responding hydrogen sensors. The system developed improved sensor response time from approximately 90 seconds to 8.5 seconds. The microprocessor works in real-time providing accurate hydrogen concentration corrected for fluctuations in sensor output resulting from changes in atmospheric pressure and temperature. Following the successful development of the hydrogen sensor system, the system and predictive methodology was adapted to a commercial medical thermometer probe. Results of the experiment indicate that, with some customization of hardware and software, response time improvements are possible for medical thermometers as well as other slowly responding sensors. Author

N93-22203*# Sverdrup Technology, Inc., Bay Saint Louis, MS. Engineering and Science Dept.
ATTIRE (ANALYTICAL TOOLS FOR THERMAL INFRARED ENGINEERING): A SENSOR SIMULATION AND MODELING PACKAGE **c35**
S. Jaggi *In* NASA, Washington, Technology 2002: The Third National Technology Transfer Conference and Exposition, Volume 2 Feb. 1993 p 501-519 (For primary document see N93-22149 08-99)
Avail: CASI HC A03/MF A04

The Advanced Sensor Development Laboratory (ASDL) at the Stennis Space Center develops, maintains and calibrates remote sensing instruments for the National Aeronautics & Space Administration (NASA). To perform system design trade-offs, analysis, and establish system parameters, ASDL has developed a software package for analytical simulation of sensor systems. This package called 'Analytical Tools for Thermal InfraRed Engineering' - ATTIRE, simulates the various components of a sensor system. The software allows each subsystem of the sensor to be analyzed independently for its performance. These performance parameters are then integrated to obtain system level information such as Signal-to-Noise Ratio (SNR), Noise Equivalent Radiance (NER), Noise Equivalent Temperature Difference (NETD) etc. This paper describes the uses of the package and the physics that were used to derive the performance parameters. Author

N93-22402# Office of Science and Technology, Washington, DC.
CAPSULE REVIEW OF DOE RESEARCH AND DEVELOPMENT LABORATORIES AND FIELD FACILITIES
Sep. 1992 140 p
(DE93-003282; DOE/ST-0002P) Avail: CASI HC A07/MF A02

An overview of the unique complex of research, technical development, manufacturing, and administrative facilities that comprise the US Department of Energy (DOE) field installations is provided. Originating in the Manhattan Project of World War 2, the DOE field facilities system has developed in several major directions. It includes the largest uranium enrichment and special nuclear materials production complex in the free world; its manufacturing facilities provide the nuclear devices for the national strategic defense system; and it develops the nuclear reactors that power the submarine fleet of the US Navy. Equally important is the growth of the scientific and technological capabilities of the system. The original concentration on nuclear physics has been broadened to encompass the entire spectrum of the fundamental sciences. Research in DOE laboratories now spans investigations into the nature of matter and chemical reactions, cosmology, the operation of biological cells, the process of genetic information coding, the ecosystem, the geosphere, mathematics and computing, and medicine. Nearly every area of basic scientific knowledge is represented in the research activities of the laboratories within the DOE field system. The 9 multiprogram laboratories and 21 program-dedicated laboratories accomplish the fundamental scientific work of the DOE field system and also the bulk of the research and development. DOE

N93-23107# Norwegian Space Center, Oslo.
[ACTIVITIES REPORT OF THE NORWEGIAN SPACE CENTER] Annual Report, 1991
May 1992 18 p Original contains color illustrations
(ETN-93-93540) Avail: CASI HC A03/MF A01

Activities of the Norwegian Space Center are reported for the following areas: telecommunication--including the building of two Norsat B stations to handle Eutelsat traffic, demonstration of TSAT data transmission system, and preparations for PSDE (Payload and Spacecraft Development and Experimentation); involvement in the Columbus Space Station program and microgravity activities; involvement in space transportation within ESA's launcher Ariane 5; involvement in Earth observation and the ERS-1 satellite; and the Auroral Imaging Observatory (Aurio), the Northern Satellite Service (NSS) (launching small satellites from Andoya), and the PULSUR and RONALD (planned within TURBO), space research projects. Reports on the Andoya rocket range and Tromso satellite station are given. Results produced from space activities are outlined. Progress within ESA by Norwegian industry are discussed. The board of directors report and key figures from annual accounts are presented. ESA

N93-23115# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
ANNUAL PROGRESS REPORT, 1990-1991
1992 121 p
(CTN-93-60695) Avail: CASI HC A06/MF A02

The activities of the University of Toronto Institute for Aerospace Studies are reviewed for 1990-1991. After presenting the biographies of the Institute's academic staff, the facilities available for experimental research are briefly described, including the Aeroacoustics Laboratory, air cushion test facilities, the flexible spacecraft simulator, shock tubes, wind tunnel, and other laboratories. Research projects are then described in the areas of flight mechanics and simulation, air cushion technology, low-speed aerodynamics, nonstationary flows and shock waves, nonstationary gas dynamics, computational fluid dynamics, aeroacoustics, combustion, propulsion, hypersonic aerodynamics, structural mechanics and advanced composite materials, materials processing in space, space robotics, space dynamics and control, applied mass spectroscopy, fusion energy, fiber optic sensors, and smart structures. CISTI

N93-23423# Technical Research Centre of Finland, Espoo. Information Service.
ONGOING RESEARCH PROJECTS AT VTT IN 1991
1992 191 p
(ISBN-951-38-3771-8; ETN-93-93689) Avail: CASI HC A09/MF A02

Information on public research projects in progress at Technical Research Center of Finland (VTT) in 1991 is presented. The entries are arranged according to the laboratory mainly responsible for the project. The projects of each laboratory are listed in chronological order. The information includes the title, organization, schedule, project code, and keywords. The yearbook contains indices of project leaders and keywords. ESA

N93-23426# Institut National de Recherche d'Informatique et d'Automatique, Valbonne (France).
ACTIVITIES REPORT 1990: PROJECTS AND SERVICES OF THE RESEARCH DEPARTMENT Annual Report [RAPPORT D'ACTIVITE 1990: PROJETS ET SERVICES DE L'UNITE DE RECHERCHE]
1990 473 p In FRENCH
(ETN-93-93692) Avail: CASI HC A20/MF A04

Projects reported relate to six programs on the following: parallel architectures, data bases, networks, and distributed systems; symbolic calculus, programming, and expert software; artificial intelligence, cognitive systems, and man machine interaction; robotics, image, and vision; signal processing; scientific calculus, modeling, and numerical software. The services are also described. ESA

N93-24095*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
INNOVATION: KEY TO THE FUTURE Annual Research and Technology Report, 1992
Dec. 1992 267 p
(NASA-TM-103599; NAS 1.15:103599) Avail: CASI HC A12/MF A03

The NASA Marshall Space Flight Center Annual Report is presented. A description of research and development projects is included. Topics covered include: space science; space systems; transportation systems; astronomy and astrophysics; earth sciences; solar terrestrial physics; microgravity science; diagnostic and inspection system; information, electronic, and optical systems; materials and manufacturing; propulsion; and structures and dynamics. CASI

N93-24435# Horizon Data Corp., Reston, VA.
MECHANICAL WORKING GROUP MEETING MINUTES
1992 276 p Presented at the Mechanical Working Group Meeting, Dayton, OH, 27-28 Oct. 1992
(Contract DE-AC01-90CE-90053)
(DE93-004884; CONF-9210225-Summ) Avail: CASI HC A13/MF A03

This document contains the minutes and viewgraphs from the October 27-28, 1992 meeting on the subject of power generation and delivery systems for military applications. Attendees represented the US Air Force and NASA. The thermal management panel reported on the capillary pump loop test facility, thermal control systems and compressors, and the oxygen heat pipe flight experiment. The aerospace power panel reported on the integrated power unit for the more electric airplane, the solar dynamic power system, the modular high temperature gas cooled reactor-gas-turbine program, the multi-megawatt CBC power system, and analytical modeling for heat pipe performance. The terrestrial power panel reported on a free piston stirling engine power generation system, fuel cell vehicles, and the advanced gas turbine project. DOE

N93-24478# Maryland Univ., College Park. Dept. of Aerospace Engineering.
[RESEARCH ACTIVITIES AND HIGHLIGHTS OF THE UNIVERSITY OF MARYLAND'S DEPARTMENT OF AEROSPACE ENGINEERING] Annual Report, 1 Jul. 1991 - 30 Jun. 1992
Sung W. Lee 30 Jun. 1992 96 p Original contains color illustrations
Avail: CASI HC A05/MF A01

The annual report for the Department of Aerospace Engineering at the University of Maryland at College Park is presented. Short biographies of the faculty are described and their publications during the past year are listed. A review of the undergraduate and graduate programs is presented. A description of ongoing research is included. The teaching and research facilities are described. CASI

N93-24570# National Inst. of Standards and Technology, Gaithersburg, MD.
JOURNAL OF RESEARCH OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, NOV. - DEC. 1992, VOLUME 97, NO. 6
1992 105 p
(PB93-143923) Avail: CASI HC A06/MF A02; SOD HC

Contents: System for Measuring Conditional Amplitude, Phase, or Time Distributions of Pulsating Phenomena; High Power CW Wattmeter Calibration at NIST; Compact Fitting Formulas for Electron-Impact Cross Sections; and Accuracy of the Double Variation Technique of Refractive Index Measurement. GRA

N93-24648# National Research Council of Canada, Ottawa (Ontario). Inst. for Information Technology.
[ACTIVITIES OF THE INSTITUTE FOR INFORMATION TECHNOLOGY] Annual Report, 1991-1992
Sep. 1992 47 p
(NRC-35023; CTN-93-60697) Copyright Avail: CASI HC A03/MF A01

The Institute for Information Technology (IIT) of Canada's National Research Council has the mission of assisting Canadian industry in achieving excellence in information technology software and systems by promoting, supporting, and undertaking focused, industry-oriented research and development programs in those areas. There are four elements to IIT's research program: software engineering, knowledge-based systems, sensor-based automation, and systems integration. Research is conducted in four Ottawa laboratories (one for each element) and one laboratory in Vancouver which focuses on systems integration for the resource industries. Research programs and activities for 1991-1992 are summarized in such areas as photonic systems (fiber optics, optically enhanced computing), sensor systems (digital imaging and machine vision), sensor-based robotics (including supervised autonomy or man-machine cooperation), the Intelligent Advisor Project, diagnostic systems, machine learning, realtime and embedded software systems, software portability and design recovery, industrial and manufacturing systems, electromagnetic protection, and support systems for the resource and transportation industries. CISTI

N93-24652# Institute for Aerospace Research, Ottawa (Ontario). Structures and Materials Lab.
RESEARCH PROJECTS Progress Report, 1990-1991
W. Wallace 1 Jul. 1992 104 p
(NRC-LTR-ST-1883; CTN-93-60704) Avail: CASI HC A06/MF A02

The Structures and Materials Laboratory (SML) is one of four laboratories of the Institute of Aerospace Research of Canada's National Research Council. The SML is concerned with research and development on matters affecting the structural design, strength, stability, durability, and structural integrity of aircraft, engines, and space structures. After an overview of the organizational structure of the SML and its interactions with external organizations, a synopsis is provided of each of the research projects that were active in the SML during 1990 and 1991. Reports and publications resulting from each of the projects are listed, and illustrations and figures are included for some of the projects. Projects are described under the following programs: aerospace structures, structural dynamics and acoustics; aerospace materials and engineering physics; and structures facilities, services and administration. Author (CISTI)

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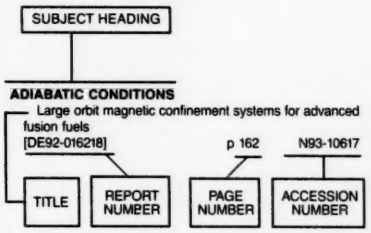

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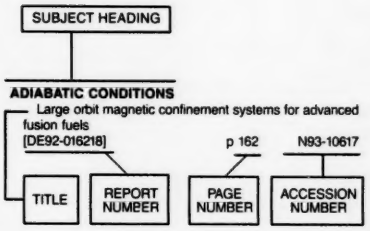

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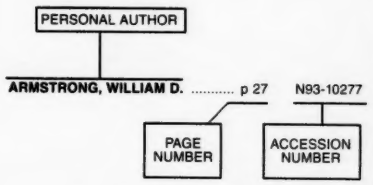

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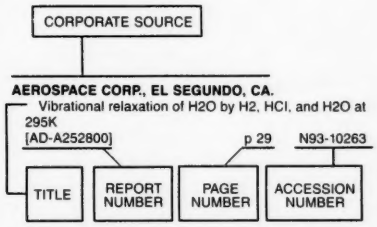

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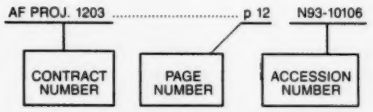

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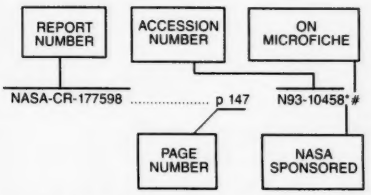

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AD-E201392 ..... p 2201 N93-24280 #
AD-E951943, : ..... p 2439 N93-23467 #

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AFESC/ESL-TR-90-02 ..... p 2408 N93-23990 #
AFESC/ESL-TR-91-32 ..... p 2224 N93-24422 #
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AFIT/GCE/ENG/92D-04 ..... p 2119 N93-22398 #

AFIT/GCS/ENG/92D-21 ..... p 2272 N93-24065 #

AFIT/GE/ENG/92D-23 ..... p 2462 N93-24066 #

AFIT/GLM/LSY-92S-20 ..... p 2526 N93-23462 #

AFIT/GSM/LSM/92S-8 ..... p 2427 N93-23660 #

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AFIT/GSS/LSY/92D-4 ..... p 2440 N93-23661 #

AFOSR-TR-93-0011 ..... p 2490 N93-24260 #
AFOSR-TR-93-0026 ..... p 2558 N93-24268 #
AFOSR-92-0996TR ..... p 2557 N93-23644 #
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AFOSR-93-0020TR ..... p 2224 N93-24423 #
AFOSR-93-0021TR ..... p 2489 N93-24240 #
AFOSR-93-0023TR ..... p 2470 N93-24245 #
AFOSR-93-0024TR ..... p 2425 N93-24297 #
AFOSR-93-0025TR ..... p 2410 N93-24470 #
AFOSR-93-0027TR ..... p 2423 N93-24420 #
AFOSR-93-0028TR ..... p 2422 N93-24247 #
AFOSR-93-0029TR ..... p 2298 N93-24246 #
AFOSR-93-0031TR ..... p 2421 N93-23459 #

AFSOR-TR-92-1005 ..... p 2557 N93-23664 #

AGARD-AR-287 ..... p 2204 N93-22998 #

AGARD-CP-524 ..... p 2254 N93-22018 #
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AGARD-CP-528 ..... p 2265 N93-23598 #

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AI-M-1392 ..... p 2471 N93-24415 #
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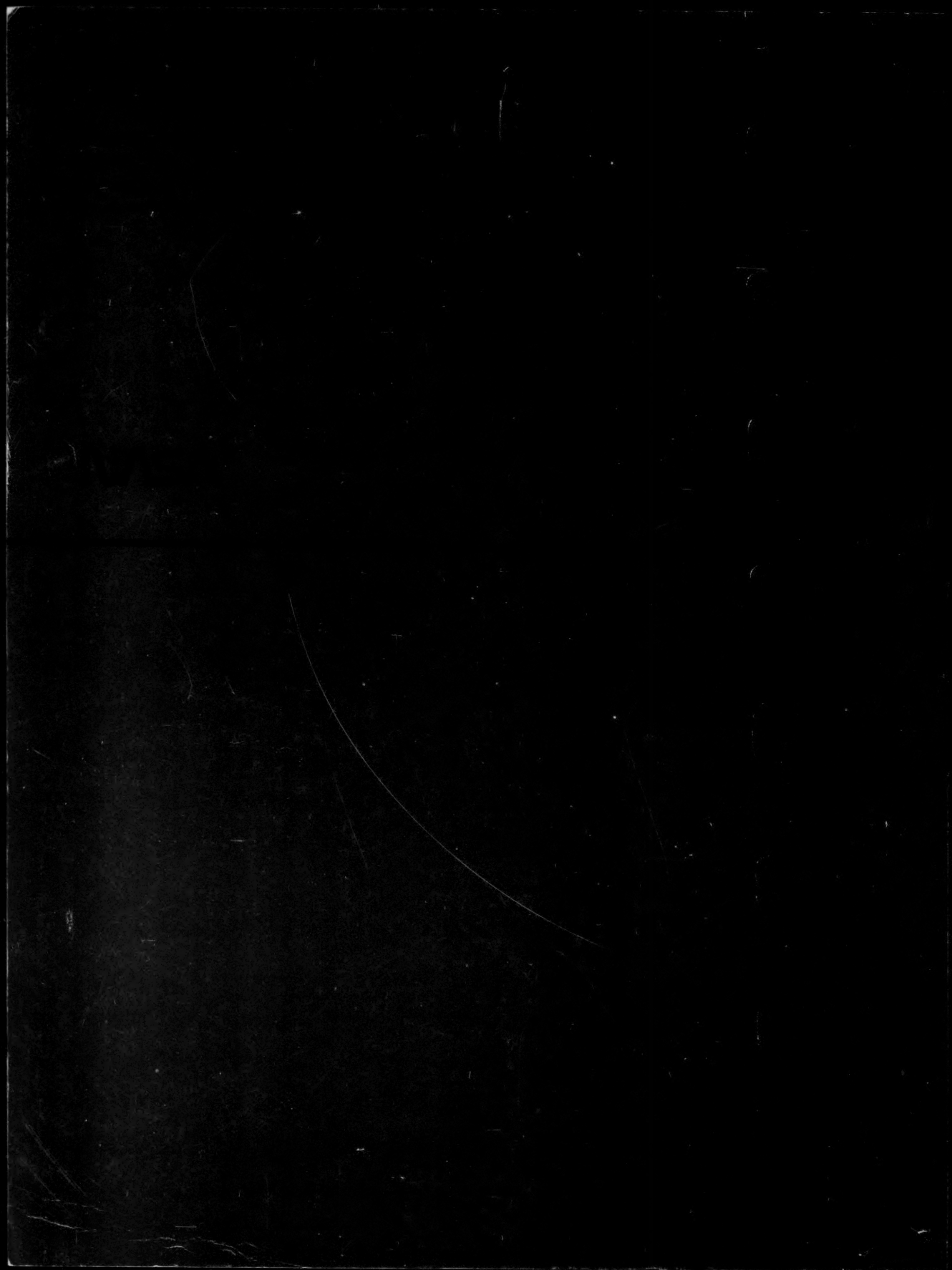
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